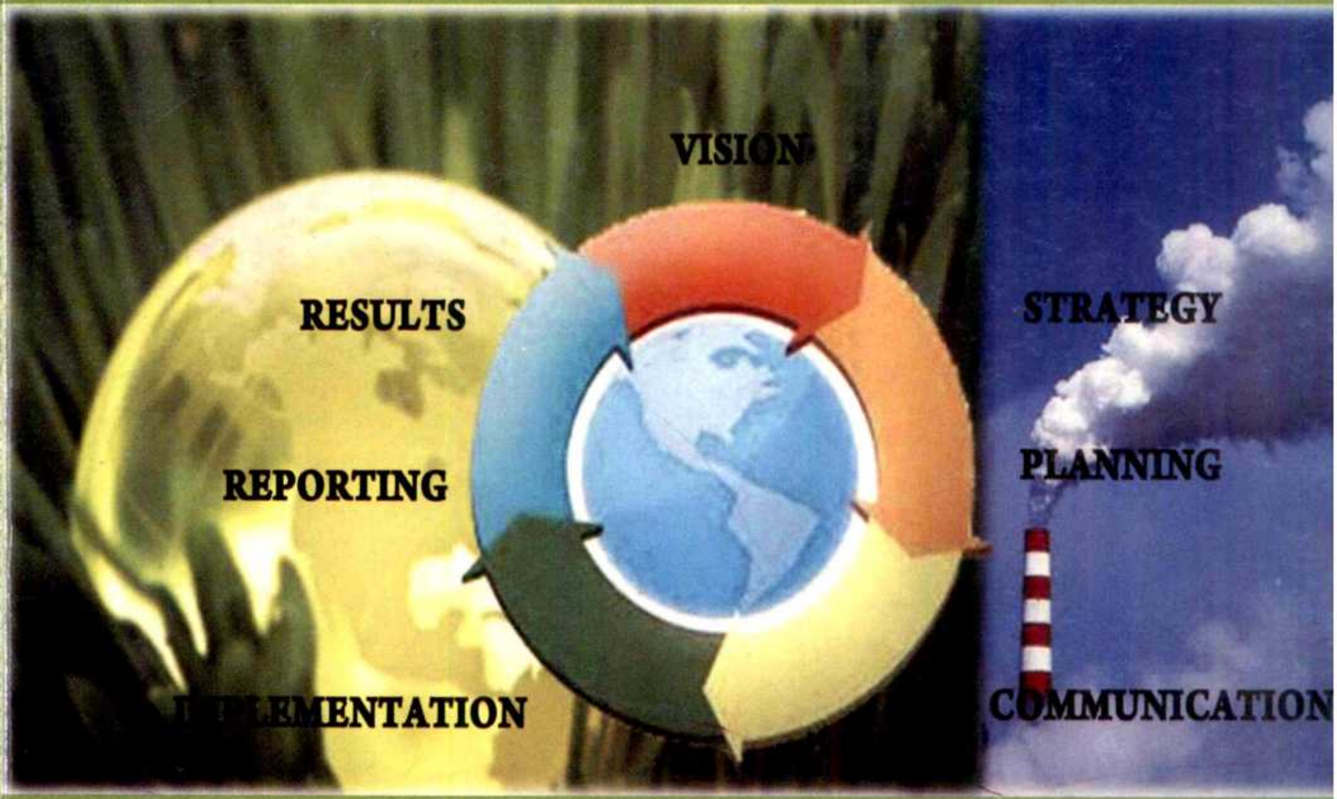
INTEGRATED ENVIRONMENTAL POLLUTION CONTROL FRAMEWORK AND STRATEGIES :

A COLLECTION OF ESSAYS AND CASES



UNIVERSITY OF CALCUTTA
2013

CUG-H05411-60-07165769

INTEGRATED ENVIRONMENTAL POLLUTION CONTROL FRAMEWORK AND STRATEGIES:

A COLLECTION OF ESSAYS AND CASES

DSA PHASE I (2011-16) PROGRAMME ON ENVIRONMENTAL MANAGEMENT

DEPARTMENT OF BUSINESS MANAGEMENT

UNIVERSITY OF CALCUTTA

60

EDITED BY

PROF. SITANATH MAZUMDAR

DR. SHARMISTHA BANERJEE

CALCUTTA UNIVERSITY
CENTRAL LIBRARY

University of Calcutta
2013

© University of Calcutta

Price : Rs. 100.00

G165769

PUBLISHED BY THE REGISTRAR, UNIVERSITY OF CALCUTTA
87/1, COLLEGE STREET, KOLKATA - 700 073
AND
PRINTED BY SRI PRADIP KUMAR GHOSH
SUPERINTENDENT, CALCUTTA UNIVERSITY PRESS
48, HAZRA ROAD, KOLKATA - 700 019.

Reg. No. 2711B

CONTENTS

Page No.

Introduction i-vi

Section A: Salient features of Environment and Resource Management in Bangladesh and West Bengal

Sub-section 1: Bangladesh

Ideology in Mainstream Economics: Unfolding 'Development' Prescriptions for Bangladesh........ *Anu Muhammad* 1-17

Energy Security and Sustainable Development: Challenging 'Resource Curse' Model in Bangladesh........ *Anu Muhammad* 18-42

Sub-section 2: West Bengal

Integrated Environmental Pollution Control Strategies in West Bengal......... *S. C. Santra* 43-57

Planning for a Sustainable Future through an Integrated Pollution Control Framework........ *Nupur Sengupta, S. Mitra and K. M. Agrawal* 58-67

Section B: New and Emerging Environmental Management Perspectives

Transforming Arsenic Crisis into an Opportunity for Economic Growth in South and South East Asia........ *Sudipta Sarkar, Hul Seingheng, Davin Uy, Anirban Gupta and Arup Sen Gupta* 68-73

Industrial Ecology – A Paradigm Shift to Closed Loop System for Waste Management........ ***K. M. Agrawal, S. C. Santra, S. Mitra and I. Sadhukhan*** 74-91

Green Development of West Bengal – Miles to go........ ***S. P. Mukherjee*** 92-96

Emerging Trends of Green Marketing in India in the Context of Global Scenario............. ***Kaushik Kundu*** 97-111

Section C: Environmental Management in Small and Medium Enterprises

A Research Framework for Environmental Performance Measurement and Management for Indian SMEs........ ***Pradip Kumar Ray*** 112-129

Micro, Small and Medium Enterprises (MSMEs) and Environmental Sustainability – Issues and Challenges in India........ ***Nikhil Bhusan Dey*** 130-146

Section D: Field level Perspectives

Lean Engineering – Based Technology Implementation Framework at Indian Air Force (IAF)........ ***Pradip Kumar Ray*** 147-172

Human – Environment Interaction – based Performance Measurement System at a Steel Plant in India......... ***Pradip Kumar Ray*** 173-200

Green Initiatives in Exide Industries Limited, Kolkata........ ***Anjan Ghosh*** 201-209

CESC Limited – Environment Management & Pollution Control Initiatives at Generating Stations........ ***Kushal Bhowmick*** 210-218

Section A

Salient features of Environment and Resource Management in Bangladesh and West Bengal

Sub-section 1: Bangladesh

Integrated Environmental Pollution Control Framework & Strategies ---
A Collection of Essays & Cases

Introduction

This volume titled, Integrated Environmental Pollution Control Framework & Strategies --- A Collection of Essays & Cases, is being published by the Department of Business Management, University of Calcutta under the aegis of its DSA Phase I (2011-16) programme. The papers which have been selected for this volume may cover a large variety of issues but is linked under the concept of integrated environmental management discussing integrated environmental pollution control framework and strategies from multi-dimensional perspectives of natural capital utilization with reference to overall economic development. The articles scrutinize the major environmental issues affecting the world in general and India and Bangladesh in particular (which are politically divided but challenged by/ or connected with the same environmental issues). The core issue is the current position and practice of environmental protection and management, vis a vis the developmental process. Some articles provide an overview of the evolution of the paradigms in environmental management and some others explore the application of innovative lean technology and policy formulation. To supplement the thematic articles, field level case studies have been collated to provide a view of strategies that have been adopted by private and public sector units to integrate pollution control measures which are appropriate with the stage in the lifecycle of the economy or industry in question.

In the last few decades, the world has recognized the significance of environmental resources as natural capital, which follows a unique pattern corresponding to varying stages of economic development. A debate has emerged over the issue that environmental degradation in an economy may initially increase, but eventually declines, as per capita income increases. The hypothesis, called the Environmental Kuznets curve (EKC) has led to a number of attempts to estimate empirically an "inverted U" shaped relationship between a variety of indicators of environmental pollution or resource depletion and the level of per capita income. In the 21st century policy makers in the government and development specialists stand at the cross roads in choosing between environmental protection and economic development. The complex intertwining of economic factors, natural resources and environment protection can no longer be adequately handled by traditional pollution control strategies and techniques. The concept of integrated environmental management provides a response to the demands for both greater efficiency and better environmental protection, with limited resources.

The integrated environmental management framework provides a suitable framework for identifying and resolving complex resource problems such as biodiversity or estuary protection, which may otherwise remain undetected in non-integrated management approaches.

In the lines of integrated management practices providing a basis for rationalizing resource policy development, the concept of integrated management can and should provide the basis for rationalizing resource policy implementation. Integrated management does this by coordinating the actions of multiple management agencies, removing redundancies, consolidating information, improving communication and promoting a holistic understanding of the environment. Therefore integrated environmental management can reduce the time and cost associated with implementing resource management activity. It can offer stakeholders of environmental resources by enabling 'one stop shopping' and convenient customer service delivery for compliances, inquiries and assistance.

Recent economic theories and empirical evidences have questioned whether poorer economies that are endowed with abundant natural resources develop more rapidly than economies that are relatively resource poor. It is possible that resource abundant economies are not reinvesting the rents generated from natural resource exploitation into productive assets, or that resource booms actually divert economic resources from more productive and innovative sectors. There is evidence of this phenomenon particularly with regard to economic development and environmental degradation in developing countries like India.

The book is divided into four Sections; Section A dealing with environment and resource management issues in India and Bangladesh. Environmental degradation has become a threat to the basic existence of people. In both neighboring regions, Bangladesh and West Bengal, policy and legal instruments for management of environment and natural resources focus on issues related to sustainable development and are more or less commensurate with global approaches. But unfortunately, institutional framework has not evolved appropriately due to lack of commitment of policy makers and politicians. As a result of that fact, environmental sustainability and human well being are in a vulnerable condition in these places.

Section B covers new and emerging practices and perspectives in environmental management which rationalize the need for integrated environmental management, in the realm of cost efficiency and effective service delivery with innovative methodologies. The articles are varied and deal with community involvement on one hand and on the other hand, introduce the notions of industrial ecology and green development with regional perspectives, wherever applicable. Green, environmental and eco-marketing are part of the new marketing approaches which do not just refocus, adjust or enhance existing marketing thinking and practice, but seek to challenge those approaches and provide a substantially different perspective.

Considering another perspective, economic and social development in developing countries, is by a large extent achieved by small enterprises. In the wake of the green movement and the significant momentum that it has gained over the recent years, SMEs' active participation is a critical measure of our nation's ability to address and react to global standards with regard to environment. Included in Section C are articles providing preliminary information on awareness & penetration of environment management practices among Small & Medium Enterprises in India and the challenge that environmental issue in connection with small and medium enterprises that takes a back seat while the employment generation role of small enterprises becomes the focal point of policy makers and business leaders. This study can be the starting point for an in depth research and capacity building exercise.

In section D, case studies from the Indian Air force, TISCO, Exide Industries and CESC (Calcutta Electric Supply Corporation) have been included. Highly specialised aspect of quality issue in the Indian Air force and in Steel manufacturing units have been discussed along with individual experiences of Exide industries and CESC that may be considered as field level perspectives of good practices.

The editors wish to acknowledge with gratitude the support provided by the referee who has kindly spent many valuable hours for his constructive comments which have made possible publication of such a volume with multifaceted linkages. We thank the authors for the preparation of the manuscript on time. Thanks are also due to our colleagues in the Department and the administrative offices, the project fellows, Shamayita Banerjee and Uma Saha who have done the laborious work of the electronic editing and the support staff in the department without which any work in this DSA programme could not be accomplished.

We should mention in this context that the errors and omissions in editing this book, if any, belong to the editors. Nobody else is responsible for the shortcomings that might remain in this collection of papers.

Disclaimer:

As it is an edited volume, the contents, facts and figures, etc presented in each article in different sections and sub-sections belong to respective author(s) only. The editors are no way responsible in this regard.

Sitanath Mazumdar

Sharmistha Banerjee

Ideology in Mainstream Economics:

Unfolding 'Development' Prescriptions for Bangladesh

Anu Muhammad[*]

Abstract

In this paper an attempt has been made to show links between ideological hegemony of neoclassical economics and policy directions to shape the peripheral economy like Bangladesh. This hegemony works for 'manufacturing consent' to run the present system of high poverty, inequality, repression and deprivation. The paper argues that, the countries like Bangladesh are being ruled by the ideas, values, and policy outcomes of the Neoclassical Economics (NCE) at different levels. Its argument, analysis and prescription are based on a system of values and knowledge that is static, articulated, non contextual and is believed of having universality, used to rationalize discrimination, grabbing in its crude form. According to this school, the society is nothing but a set of calculating individuals who are rationally pursuing the objective of maximizing utility in a harmonious way. Class, gender, race, environment and therefore the question of inequality and deprivation are practically irrelevant and irrational in this discourse. Hegemony of this line of thinking amongst academics especially economists and policy makers make grabbing, occupation and destruction easy and legitimate. Sustainable development is threatened.

Introduction

Like all other discipline of knowledge, Economics too does not have a single voice. But we always experience pervasive presence of a single one around us that is in broader term can be named as corporate economics. More importantly, we confront all out attempts to keep its domination and to present it as a single source of knowledge, wisdom and the single mode to find the way to prosperity. Most of the textbooks we read, the examples we study and the models we are acquainted with are clearly biased towards profiteers along with its blindness on class, gender and environment. Justification to confine Economics study to a

---

[*] Professor, Department of Economics, Jahangirnagar University, Bangladesh.

certain school and marginalizing all other schools of thought or dissenting ideas comes as an excuse of success (of career) and the necessity (of market). This is a vicious cycle, perpetuating the same species of intelligentsia especially economist who can think act or ride in a way defined by the power.

Therefore analyzing career path of economists and experts from a promising student to that of a 'successful' professional, be it as teacher at home or abroad or as researcher or as policy maker or an executive in 'development' agencies, or boss in corporate house gives a clear picture of construction of a person to become a tool of a broader machine. This hegemony works for 'manufacturing consent' to run the present system of high poverty, inequality, repression and deprivation. It is not therefore possible to conceive a new order for the country and humanity without understanding and rejecting this hegemony.

In this paper I would like to show how ideological hegemony of neoclassical economics gives validity to policy directions to shape the peripheral economy like Bangladesh. This hegemony works for 'manufacturing consent' to sustain the present system of high poverty, inequality, repression and deprivation.

Genealogy of the 'value free' Economics

Most dominant is the Neoclassical Economics (NCE) along with its different sheds in corporate galaxy. NCE has its continuity with classical school in its ideological essence. It considers capitalism as irreplaceable and the best possible system for human civilization and use invisible hand framework for their analysis.

In the later part of nineteenth century two increasingly diverse trends developed in Economics. On the one hand, classical labor theory of value developed further into Marxian analytical system, that took a 'dangerous' path suggesting a radical break in socioeconomic formation, beyond Capitalism. On the other hand, with utility theory NCE proceeded to philosophically contain property and power system of capitalism.

These two contradictory trends can be shown in the following way:

1. Labor theory of value→social classes→social conflict→class struggle→social transformation.

2. Utility theory of value→combination of homogeneous, self seeker, calculating consumers→ social harmony→invisible hand →continuous growth.

William Stanley Jevons (1835-1882), Carl Menger (1840-1921) and Leon Walras (1834-1910), initiated the version of the utility theory of value that remains at the heart of neo-classical orthodoxy to this day. Bentham's ideas were the starting point of Jevon's theory. He attempted to study economy as a 'calculus of pleasure and pain' of individuals where every person is a 'rational, calculating maximizer'. Fundamental assumption is that, if two parties participate in exchanges then both are benefited. Exchanges harmonize everyone's interest. This 'everyone' is equal and sovereign in the market. Discrimination of class, gender, race, religion in the society is therefore considered irrelevant.

Menger argued that, inputs were being paid according to their productivity; therefore no surplus is left to expropriate by anybody. It was also argued that the society was an organic whole that had evolved with an inherent, deterministic necessity to its existing state. Social institutions and laws could not and should not be tempered with. Accordingly, he also argued that "what was commonly designated by 'national economy' was nothing but an organized complex of individual economies" (Hunt, 1979). He expressed his disliking on the term 'national interest'.

Two major assertions on the methodology by them are notable. First, since 'pure science' is always value free, so, economics is 'value free'. Second, economists can only scientifically understand individual households or business firms (in Menger's words, 'individual economies'). Economists can never develop a similar scientific understanding of social aggregates such as classes or nations.

Walras identified the existing laws of distribution of property as morally right and just, as he said, 'the ownership of property...is legalized appropriation, or appropriation in conformity with justice'. He assumed that the economy was made up exclusively of small, relatively powerless business firms, and perfect competition prevailed. He ignored monopolies throughout his general equilibrium discussion except few words in the last part. Walras attempted to formulate a general theoretical framework, where all prices could be determined simultaneously, through the interaction of all markets. Alfred Marshall

(1842-1924), went beyond Jevons, Menger and Walras in contributing to utility theory and in consolidating a new school of thought.

In neoclassical theoretical framework, economics is organized like natural sciences, physics in particular. But at the same time objective theory of value has been substituted by a subjective one. Here all values are considered as individual and subjective (Screpanti and Zamagni, 1993). While classical laissez-faire had focused on the problem of accumulation, neoclassical laissez-faire was oriented more towards the problem of allocative efficiency (Ibid).

Emergence of this school took place as a response to the need of a material world that became visible at the time. Doctrine of 'Social Darwinism', i.e., argument of 'survival of the fittest' provided the ideological support to build that. In that context, "it was necessary to 'reinvent' economic science, reconstructing it on a foundation which would allow the deletion of the concepts themselves of 'social class', 'labor power', 'capitalism', 'exploitation', 'surplus', etc. from the body of the science. The theory of marginal utility provided the solution" (Screpanti and Zamagni, 1993).

Hunt analyzed it in detail and said that the neo classical economics had its own beauty and vulgarity. He summarized essence of this school, the foundation of which was built on following assumptions:

1. Invisible hand argument, i.e., free market exchange creates harmony among all people's interests, creates rational prices and ensures an efficient allocation of resources.

2. Free market automatically creates conditions for employment generation and high employment equilibrium.

3. Distribution of income is determined by the marginal productivity of the different factors of production automatically (Hunt, 1979). Therefore, issues like 'exploitation' 'deprivation' 'inequality' became *irrelevant,* non-existent in this model of analysis[1].

---

[1] One may notice that the Neo-classical approach has a strong foundation of its "belief system" not weaker than any religious belief. Therefore one may call it new scholastic!

Moreover, neoclassical analytical framework tends to reduce the theory of production and distribution into merely a theory of exchange; consumption involves merely exchanges among persons, while production is exchange with nature[2]. This is the essence of utilitarian approach. According to this frame of thinking, all human behavior involves exchange, all human being choose 'rationally'. Since all human activity is assumed as exchange, each and 'every aspect of capitalist society is rational and blissful'. It was even claimed that all forms of sexual relations or even child production, child rearing including child beating are merely a series of rational utility maximizing exchanges (Schwarts, 1977).

Neo-classical school, like its predecessor, considers capitalism a system of permanence, a historical and irreplaceable. This school of thought, nevertheless, is not a homogeneous body of thought. It has different shades, sometimes conflicting and even hostile, within its broad common framework. The sheds that developed in post-world war period can be divided into two semi-broad trends. One can be called as liberal school led by Paul Samuelson and another as conservative school led by Milton Friedman. Both of these groups own the fundamentals of neo-classical economics. Differences between them are in approaches those have also important policy implications.

Liberals recognize the absence of the perfect competition and seem to accept the fact that the 'free market capitalist system is unstable, being subject to recurring depressions that incur enormous social waste'. Government of any country, they argue, 'can drastically mitigate, if not eliminate, this instability by using appropriate monetary and fiscal policies'. Samuelson argued in favor of the mixed economy, 'the mixture being one of the invisible hand of the market and the visible fist of the government' (Samuelson, 1993).

Samuelson has been in favor of 'workable competition' and to ensure 'public vigilance' and 'government intervention'[3]. He also recognizes the existence of 'public goods', which is socially necessary but not profitable for the private investors. Considering real world of capitalism, liberals including Samuelson have been 'skeptical to rely 100% on invisible hand for rational distribution and efficient allocation of resources'. Samuelson's 'undogmatic way to approach reality is capable to read the fact and make an approach workable' (Hunt, 1979).

---

[2] "One can rarely find in the *American Economic Review*, or any of the other prestigious journals of the profession, reference to the specifically capitalist nature of the 'system' whose properties are under examination. This omission would be instantly noted were the journals that discussed medieval life never to include the word 'feudalism'" (Heilbroner and Milberg, 1995, p. 6).

[3] "It is not my belief that any interferences with laissez faire are on balance harmful. The neo-classical economists of goodwill had a noble and feasible vision. They advocated redistributive taxation and transfers to reduce the stark inequalities of laissez faire. Marshall, Wicksell and Pigou are instances in point. Economists also advocated macroeconomic stabilisation, whether of the Irving Fisher 1920 variety, the Keynes-Ohlin 1937 variety, or the Tobin-Friedman 1980 variety"(Samuelson, 1993, p.71).

Keynesian economics emerged to combat capitalist crisis that came into surface during the 'great depression'. This crisis in fact threatened fundamental beliefs, such as, the existence of perfect economy among the policy makers. Therefore it questioned the ideology of market automaticity, and the adequacy of the analysis of 'individual' economies. The founder of that school JM Keynes (1883-1946) developed analysis on aggregate economy, role of the government and necessity of public expenditure. Keynes was aware of capitalism's cruel face; he wanted to restrict its limit. He said, 'I believe that there is social and psychological justification for significant inequalities of incomes and wealth, but not for such large disparities as exist today' (Keynes).

Government intervention was the crucial point of Keynes's departure from neo-classical. He responded to the fellows by saying that, 'whilst, therefore, the enlargement of the functions of government, involved in the task of adjusting to one another the propensity to consume and the inducement to invest, would seem to a nineteenth century publicist or to a contemporary American financier to be a terrific encroachment on individualism, I defend it, on the contrary, both as the only practicable means of avoiding the destruction of existing economic forms in their entirety and as the condition of the successful functioning of individual initiative' (Keynes). This argument, 'practicable means of avoiding the destruction of existing economic forms in their entirety', seems to be the guiding force of liberals. The accommodating framework developed by liberals later became known as 'Neo Classical Synthesis'.

Dogmatic presentation of the neo-classical economics can be found in Austrian School (Ludwig Von Mises, Fredrich A. Hayek) and Chicago School (Milton Friedman)[4]. These orthodox schools seem to be very much uncompromising in their values and belief system, despite their claim of economics as 'value free science'[5]. Friedman and his school always stand on rigid value system, with strong assumption of existence of 'perfectly perfect' competitive economy. On that premise they have always been strong advocate of the elimination of 1. taxes on corporations 2. the graduated income tax 3. free public education 4. social security 5. government regulations for the purity of foods and drugs 6. the license and qualifying of doctors and dentists 7. the post office monopoly 8. government relief for natural disasters 9. minimum wage laws 10. ceilings of interest rate charged by unions lenders 11. law prohibiting heroin sales, prostitution, pornography, etc.

---

[4] "Forty years after Friedrich Hayek wrote down his nightmare of the welfare state leading remorselessly to the totalitarian murder of freedom, Scandinavians enjoy freedom second to none that the world has ever seen; and, contrary to the logic of *The Road to Serfdom*; societies such as Chile and Singapore with maximal market freedoms live under dictatorships that suppress civil liberties"(Samuelson, 1993: p.59).

Friedman accused United States for being '40 percent socialist'! He has been a strong critique of the U.S. government for regulating quality control of food, medicine, controlling speed of car, forcing to use seat belt, public expenditure on education and health etc (Friedman, 1962, 1990).

Later 'new classical economics', sometimes called 'rational expectation school', became dominant in the mainstream economics during 80s, had many things common with Friedman. It seems that its strength lies in 'rigor rather than relevance'. Alan Blinder called the 'rational expectations revolution' as 'godsend for aspiring young technicians' (Blinder, 1988). Blinder also saw the rise of Reagan-Bush presidencies as a parallel of this new classical economics. Its central thesis of 'governmental impotence'[6] and rejection of many social elements from the 'economic science' gave big corporate bodies a renewed theoretical weapon to assert their agenda. Blinder further said, 'the relative strengths of conservative and liberal ideology obviously vary both over time and through space. My argument is that (anti-Keynesian) new classical theory could have attracted a large following only in a country at a time when right-wing ideology was on the ascendancy, as was true in the United States in the 1970s and 1980s' (Blinder, 1988). This school is still dominating globally, although US and Euro zone financial crisis has shaken its credibility to a great extent.

---

[5] "In the 1950s and 1960s economists learned their methodology from Popper. Not that many of them read Popper. Instead, they read Friedman and perhaps a few of them realized that Friedman is simply a Popper-with-a-twist applied to economics. To be sure, Friedman was criticized, but the 'Essay on the Methodology of Positive Economics' nevertheless survived to become the one article on methodology that virtually every economist has read at some stage in his career." (Blaug,1988: p360)

[6] But the pioneer of free market economics Adam Smith categorically assigned three duties to the government in his laissez faire model:

1. The duty of protecting the society from violence and invasion of other independent societies.

2. The duty of protecting, as far as possible, every member of the society from the injustice or oppression of every other member of it, or the duty of establishing an exact administration of justice.

3. the duty of erecting and maintaining certain public works and certain public institutions, which it can never be for the interest of any individual or small number of individuals, though it may frequently do much more than repay it to a great society" (Smith, 651).

Despite internal beauty, this school became most powerful ideological weapon for the global corporate body to grab, evict, colonialize, exploit and dominate. Smith or Marshall probably could not even dream of that possibility. The advocates of this school do not really recognize any changes occurred in real economy since then[7].

Construction of the Economists

It is a matter of common sense that the economists are not 'value-free'; they have their own value judgment. Like anybody else, economists too represent certain class or social group.

Global capitalism needs economists of specific variety to implement their agenda[8]. This is not surprising, therefore, that the Pentagon or US defense department itself put deep interest in mobilizing resources in capturing intellectual resources including economists.

In 1958, the Department of Defense spent $91 million in support of 'academic research'. By 1964, the sum had reached $258 million and by 1970, in the midst of the Vietnam War, to $266 million. By 2003, however, any of these numbers, or even their $615 million total, was dwarfed by the Pentagon's prime contract awards to just two schools, the Massachusetts Institute of Technology and Johns Hopkins University that, together, raked in a combined total of $8.4 billion (Turse, 2004).

---

[7] 'In one sense Marshallian economics has passed away already. His vision of the economic process, his methods, his results, are no longer ours. We may love and admire that mighty structure which, battered by the impact of criticisms and of new ideas, still spreads its majestic lines in the background of our own work. We may love and admire it as we love and admire it as we love and admire a Madonna by the Perugino, recognizing that she embodies to perfection the thought and feeling of her time, yet recognizing also how far we have traveled from her....' (Schumpeter, 1966)

[8] Best example so far is the 'value free' economist like Milton Friedman, who served Chilean dictator Pinochet. 'Value free' institutions like the World Bank or IMF always patronize or feel free with the dictators, corrupt ruling elites and the big corporate agenda.

Nurturing of specific school of economics by agencies representing big corporate bodies can explain its gender-class-race blindness. We also find patronizing pattern very well organized. Even publications, hiring, allocation of research funds are also highly controlled. A study reveals that, 'those who hold positions at the few 'top' universities carry a disproportionate amount of power over hiring, publishing, and the granting of research funds. The hiring of new economists by the leading universities is limited to those trained at only a few selected graduate programs. And the major academic journals are equally dominated by articles written by economists from those same schools. Graduates of only seven departments accounted for 54%, 58% and 74% of articles published in the *American Economic Review,* the *Journal of Political Economy,* and the *Quarterly Journal of Economics'* (Heilbroner and Milberg, 1995).

The diagram of economists, in line of class, color and gender, shows a significant pattern. Another study very understandably finds that, 'the economics profession is much more male oriented than the social sciences in general, political science, or even engineering and other applied and basic sciences. In 1997, 14.3 percent of AEA members were female and 13 percent were black, Hispanic, or of other nonwhites ethnicity' (Smith, Pardey and Chan-Kang, 2004).

They also found that, 'The overwhelming majority of professional economic associations are located in developed countries, 69 percent. .....as is the case for many other knowledge-generation and transfer industries, populations in poor countries are much more inadequately served by economists than are populations in rich countries' (Ibid).

Another point is very noteworthy here. In 1993, only 15.1 percent of all economists were employed in educational institutions while 53.4 percent were employed in business and industry and 31.5 percent in government. In 1997, the proportion of economists employed in education had declined to 9.5 percent and the proportion employed in government had declined to 27.5 percent, while the proportion employed in business and industry had increased to 63 percent (Ibid).

Referring IMF's role in managing economic crisis in East Asia and elsewhere, Joseph Stiglitz brought an insider's view revealing to understand how the economists in the most powerful institutions work[9]. His descriptions give a bleak picture. There are many reasons why these agencies need submissive people with technical ability, who prefer to be robotic.

And what about the economists in a country like Bangladesh? Not very different. In fact, 'mainstream' economists of Bangladesh are part of international consultant community who think, act, speak and write in similar breath. Rehman Sobhan, one senior economist of Bangladesh, stated back in 1985 that, 'economists have now become one of the principal beneficiaries of the hundreds of millions' dollars being spent by the UN system and international financing agencies to 'understand' what is poverty and underdevelopment'(Sobhan, 1991). No visible changes can be located since that time.

Gradual shifting of the economists' from studying development issues in comprehensive way to studies in compartmental way can be explained by this incentive system. Moreover, poverty study became abundant due to restructuring of so-called 'donor' agenda by incorporating poverty issues as a part of 'safety net'.

In economic writings, therefore, class analysis, exploitation, investigating the causes of poverty becomes very rare. This phenomenon, however, is not specific to Bangladesh[10]. The reduction of the economists to a level of technician has also effects on teaching in economics and therefore 'perpetuating the same trend for generations to come and reproduction of the same species'.

---

[9] 'When the IMF decides to assist a country, it despatches a 'mission' of economists. These economists frequently lack extensive experience in the country; they are more likely to have firsthand knowledge of its five star hotels than of the villages that dot its countryside. They work hard, poring over numbers deep into the night. But their task is impossible. In a period of days or, at most, weeks, they are charged with developing a coherent program sensitive to the needs of the country. Needless to say, a little number-crunching rarely provides adequate insights into the development strategy for an entire nation. Even worse, the number-crunching isn't always that good, The mathematical models the IMF uses are frequently flawed or out-of-date. Critics accuse the institution of taking a cookie-cutter approach to economics, and they're right.' Joseph Stiglitz: An insider's View. http://findarticles.com/p/articles/mi_m2465/is_6_30/ai_65653647/?tag=content;col1

[10] Jean Dreze correctly pointed out that, ''Exploitation' does not belong to the standard vocabulary of mainstream economics. It is quite possible to complete PhD in a leading economics department without having heard about the notion' (Dreze, 2002).

World Bank and IMF: Prescriptions Unfold

Economics of the World Bank IMF, managers of the corporate world, is certainly neo-classical economics with clear bias for the orthodox variety. This confirmed ideological position makes them useful tool of US and imperial hegemony and can explain their systemic bias for military or civilian dictatorial regimes. The World Bank with its visible fist ensure an economic return on its lending, but often it asserts its agenda to give the peripheral economies a direction and ensure its 'reform' programs to make it compatible to big private business, MNCs in particular, whatever it costs to people and environment. Like many other counties Bangladesh has been glued to this vulgar 'development paradigm'.

As a whole, the dominant development paradigm does not have any vision of balanced productive growth as well as ensuring energy security, food security and human security. It has many economic programs for creating unemployment, poverty, inequality and deindustrialization, turning public property into private ones, destruction of environment and misuse of potential human development though. Long words of social safety net, glorification of micro credit and NGO activities cannot mitigate disaster and wounds created by their 'development' projects.

Usually projects of World Bank in the peripheral economies go through several steps like 1. identification, 2. preparation, 3. appraisal, 4. negotiation, 5. implementation, 6. supervision and 7. evaluation. In every step World Bank has the scope to impose different conditionalities[11]. As the Bank lead 'aid clubs' participated by different investor-creditor countries, it has overwhelming authority to supervise and control almost all foreign funded projects. Cheryl Payer (1982) rightly observed that, sometime, the Bank's 'cost benefit analysis become cosmetic analysis as the projects are of course chosen a priori on purely political grounds'.

---

[11] For more discussion see, 'Economics of the World Bank: Growing Resources Increasing Deprivation' in Muhammad (2011).

She was also right when she described the civil services of a borrowing country as 'fifth column' of the World Bank. Other findings also support this view, such as, 'by the 1980s, in almost all developing countries some economic officials (and/or influential private economists) had spent some time as staff members of the IMF, the World Bank, or the regional international development banks... Often, alumni of the international financial institutions played key roles in the dual political game of adjustment. They interpreted external pressures and attempted to persuade their colleagues in domestic decision making circles, and they interpreted internal constraints and attempted to persuade their former associates in dialogue with external agencies' (Haggerd and Kaufman, 1992).

The World Bank, like the IMF, has a consistent tradition of avoiding any responsibility of the disaster created by the projects imposed or funded by them. Although they formally advocate for 'value free economic behavior', their bias for military or civilian dictatorial regimes and for the big business groups has never been a secret affair.

The table below summarizes issue priorities and policy packages of the World Bank and its beneficiaries.

Table 1: Prescribed Policies and the Real Beneficiaries

Prescription	**Cause shown**	**Incentive**	**Beneficiaries**
Don't raise wage. Lower wage	keep production cost low	more funding will be available and/or old funding will continue	local and foreign investors
Raise price of utility: gas, water, electricity	to rationalize price in line with international price and production cost.	more funding will be available and/or old funding will continue	interested investors in these sectors would feel comfortable
Privatize loss making state owned enterprises	reducing wastage and load on public expenditure.	more funding will be available and/or old funding will continue	new private owner, international investor would feel better without strong competitor
Privatize profit making state owned enterprises	this is not government's job	more funding will be available and/or old funding will continue	new owner who gets with minimum price. international investor would feel better without strong competitor
Devalue currency	raising competitiveness	more funding will be available and/or old funding will continue	exportable items would be cheaper, real income of dollar-earner would increase

There are evidences that, World Bank's enthusiasm for 'development' in some countries or its indifference to crisis of some other countries have links with the US corporate interest and its foreign policy[12]. Therefore, conditions applied to resources from the World Bank often have both economic and political dimensions. Such strategy was also acknowledged by the World Bank itself (Edwards, 1995).

Since independence (1971) global agencies including the World Bank and the IMF started emphasizing 'structural' changes according to its line of 'reform' in Bangladesh. Their development funding, in many ways, influenced or guided government programmes. These agencies have been working with very clear agenda- increasing privatization, liberalization and corporatization included[13].

The following Table shows major thrust of the World Bank in Bangladesh.

Table 2: World Bank's Programmes in Bangladesh

Area	**Essence of the programs**
Public sector fragmentation and Privatization. Opening up common resources for big business	: Different projects to reform management and increase of private business participation; : Credit to either close down and/or to privatize Jute mills. : Credit to restructure or reorient investment program of public institution to involve MNCs in energy and power sector : Restructure nationalized commercial Banks for handing over to private sector. Close down branches. : Lead and coordinate privatization of health sector (HPSS). : Lowering wage.

---

[12] Lending support to South Vietnam or South Korea's pro-US regime, hostility to Allende government and sudden change of policy towards Chile after fall of elected government and military takeover there, or after reinstatement of President Aristide and after in Haiti, long hostile policy towards Cuba or policy towards Iraq or Afghanistan all are closely linked with the US led global politics and investment strategy.

[13] For detailed discussion see Muhammad (2004) and Muhammad (2006).

Area	Essence of the programs
Preparing field for FDI with public money	: Support private sector participation in energy and infrastructure. : Provide partial risk guarantees for power and gas. : Facilitate entry of multinational transmission and distribution companies. : Facilitate water sector privatization. : Campaign for sub regional joint projects. & ADB, IMF: Raising price of goods and services.
Infrastructure for investment	: Address telecommunication (privatization) : Facilitate foreign private investment in energy infrastructure and port facilities.
Reorientation of institutions	: Reorientation of public institutions (corporatization). : Extend financial sector reforms to Banks (privatization). & UNDP, USAID: support and market orientation of NGOs and public institutions.
Export orientation Market creation and expansion	: Develop fisheries and increase commercial production of fisheries including for export. : Support export oriented enterprises. & IMF: Devaluation : Fertilizer, seed, pesticide marketing. & ADB: Water projects. & CIDA: Microfinance

A major part of this table is demystified version of the table presented in (ADB, 1999)

Almost every sector of Bangladesh has been glued with the 'development' projects funded, monitored and directed by the global agencies. Energy sector of Bangladesh is a clear evidence to understand how the 'development' direction has been systemically organized in order to ensure global corporate interest at the expense of people and environment (Muhammad, 2011).

Conclusion

The countries like Bangladesh are being ruled by the ideas, values, and policy outcomes of the corporate economics (NCE). This goes well with the interests of the local ruling classes too. The global institutions like the World Bank and the IMF have been the major actors in determining the shape and directions of these economies for more than six decades. The analytical framework of these institutions, its argument, analysis and prescriptions are used to rationalize corporate grabbing in its crude form. According to this school, the society is nothing but a set of calculating individuals who are rationally pursuing the objective of maximizing utility in a harmonious way. Class, gender, race and therefore the question of inequality and deprivation are practically irrelevant and irrational in this discourse[14].

Hegemony of this line of thinking make grabbing, occupation and destruction easy and legitimate. In Bangladesh, while FDI in natural gas sector has become a huge liability for the economy, it has been hailed as a huge success of economic policies; closure of manufacturing units was highly scored as successful reform; withdrawal of state responsibility from public education and health care add credentials to the government! In this model, privatization of common property, grabbing of natural resources appear as progress, destruction of wetland or cropland in favor of profitable business are seen as development, dismantling of public institutions are seen as a way to growth. Organized mystification of the role of the global institutions like the World Bank or the IMF makes it possible to present them as development agencies or donor agencies. Their financing to mould economies according to the needs of monopoly capital and corporate bodies are glorified as the flow of 'foreign aid'.

The values of this 'value free science' carries, the ideology this 'ideology neutral precise science' propagate, ensure reign of profit making ventures at the cost of human and environmental lives. It is, therefore, necessary to continue study the links between this poisonous 'development' with that of its ideological tool: Neo (w) classical Economics.

---

[14] "What most economists would classify as *noneconomic* problems are precisely those problems that are incapable of being analyzed with the *marginalist* paradigm" (Silberberg, 1990, p.2).

Actually we have had enough of World Bankian vision and practices. Instead if we really mean any substantial change and dignified presence in the near future we have to clarify and strengthen the vision of another world. In order to do that, it is necessary to intervene in theory, coming out of the role of echoing dominant ideologically charged but bankrupt theories and inappropriate analytical tools or doing copy and paste works as employee of the agencies of global masters. It needs no mention that, it is impossible to challenge the dominant one sitting within their ideological frame and vision box.

References:

Blaug, Mark (1985) *Economic Theory in Retrospect,* NY.

Blaug, Mark (1988) "*Paradigms versus research programmes in the history of economics*" in Hausman (ed) *The Philosophy of Economics, An anthology,* US.

Blinder, Alan (1988) "*The Fall and Rise of Keynesian Economics*", *Economic Record,* 64, December.

Dreze, Jean (2002) On Research and Action, *Economic and Political Weekly*, March 2.

Edwards, Sebastian (1995) "*Why are Saving Rates so Different across Countries? An International Comparative Analysis,*" NBER Working Papers 5097, National Bureau of Economic Research, Inc.

Friedman, Milton (1962) *Capitalism and Freedom*, USA.

Friedman, Milton; Ross Friedman (1990) *Free to Choose*, USA.

Haggard, Stephan; Robert R. Kaufman (1992) (ed.) *The Politics of Economic Adjustment,* USA.

Hausman, Daniel M. (1988) (ed.) *The Philosophy of Economics, An anthology,* US.

Heilbroner, Robert; William Milberg (1995) *The Crisis of Vision in Modern Economic Thought*, Cambridge University Press.

Hunt, E. K. (1979) *History of Economic Thought, A critical Perspective,* US.

Jevons, William Stanley (1970) *The Theory of Political Economy*, 1871 (2nd ed. penguin, 1970).

Keynes, J. M. (1960) *General Theory.*

Marshall, Alfred (1890) *The principles of Economics.*

Menger, Carl (1950) *Principles of Economics,* 1871, NY.

Muhammad, Anu (2004) *'Bangladesh Waterlogged Again', Economic and Political Weekly,* July 31-August 6.

Muhammad, Anu (2006) *'Globalisat tion and Economic Transformation in a Peripheral Economy, Bangladesh experience'*, Economic and Political Weekly, April 15-21.

Muhammad, Anu (2011) *Development or Destruction, Essays on Global Hegemony, Corporate Grabbing and Bangladesh,* Sraban, Dhaka.

Payer, Cheryl (1982) *World Bank*, MR.

Samuelson, Paul (1993) *Economics.*

Schumpeter, Joseph A. (1966) *Ten Great Economists,* UK.

Schwartz, Jesse (1977) (ed.) *The Subtle Anatomy of Capitalism*, USA.

Screpanti, Ernesto; Stefano Zamagni (1993) *An Outline of the History of Economic Thought.*

Silberberg, Eugene (1990) *The Structure of Economics: A Mathematical Analysis,* (2nd ed. New York: McGraw Hill).

Smith, Adam (1973) *An Inquiry into the Nature and Causes of the Wealth of Nations.*

Smith, Vincent H.; Philip G. Pardey; Connie Chan-Kang (2004) *"The Economics Research Industry"* in Philip G. Pardey & Vincent H. Smith: *What's Economics Worth? Valuing Policy Research*, IFPRI, London.

Sobhan, Rehman (1991) (ed.) *Structural Adjustment Policies in the Third World*, UPL.

Stiglitz, Joseph (1999) *'An insider's View'.* http://findarticles.com/p/articles/ mi_m2465 /is _6 _3 0/ai_65653647/?tag=content;col1

Thompson, Herb (1997) *"Ignorance and Ideological Hegemony: A Critique of Neoclassical Economics"*, Journal of Interdisciplinary Economics, 8(4): 291-305.

Nicholas, Turse (2004) *'Militarization of Academia: Wrestling the Military-Academic Complex'*, www.meghbarta.org

Walras, Leon (1954) *Elements of Pure Economics,* 1874, Arwin.

Energy Security and Sustainable Development: Challenging 'Resource Curse' Model in Bangladesh

Anu Muhammad*

Abstract

This article is an attempt to examine myth and reality regarding natural resources and energy security in peripheral economies with special focus on Bangladesh. It includes global experiences with revealing fact that, resource abundance does not automatically ensure development of a country. It has brought together facts and figures to show that the countries like Bangladesh do not suffer, as commonly shown, because of capital or resource scarcity, not even for lack of technology or skilled human resources. On the contrary, sufferings originate from local hegemonic rulers and global alliances that, in the name of development, place grabber-friendly policies and therefore use corrupt practices for extracting disproportionate private profit from common property. This author would like to insist that, energy resources from the nature are common property. In order to make development meaningful and sustainable, this must remain so. In order to maximize potential use of natural resources, planned development of national capability is the most essential pre-condition. For Bangladesh, prohibitions to exporting mineral resources and to open-pit mining are also very strong pre-conditions to ensure energy security and sustainable development. Main argument of this paper is that, energy-sovereignty is the key to energy security and therefore sustainable development.

Introduction

Studies on different countries clearly show that, resource abundance does not automatically ensure sustainable development. For many countries, under certain conditions, resources may

---

* Professor, Department of Economics, Jahangirnagar University, Bangladesh.

become a curse. 'Resource-curse' phenomenon is now a real issue. It is evident that militarization, war, and conflicts have been closely linked to exploitation of energy resources. It may sound contradictory but this is a reality that corruption, poverty, inequality, and repression go hand in hand with exploitation of natural resources for many countries. Packaged programmes of 'development' and 'economic reform' imposed by the international finance organizations, such as World Bank and IMF, have been proved to be disastrous for peripheral economies. These programmes created more energy insecurity and development that is not sustainable. Increasingly deregulated and speculative investment in oil and mineral resources in the last decade created artificial crisis, more distorted market and price hikes.

This paper analyzes the issue from historical as well as global perspective in order to understand this resource-curse phenomenon as it relates specially to Bangladesh. After conceptualizing energy security and sustainable development, the 'resource-curse' model is elaborated as it appears in many peripheral countries. Experiences of foreign direct investment (FDI) in energy sector and export promotion policies (campaign) of those resources are then examined. Different countries with different resource domain and with different state policies are examined briefly in distinct four groups. In the second part, Bangladesh's energy resources and related policy implications are explored. Factual evidences and documents are examined to understand the reasons behind people's resistance to public policy directions. Peoples' struggles and aspirations regarding the prospects in the energy sector in Bangladesh have also been focused in this paper.

Energy: Resource and Security

Energy Security is the key to sustained development of any country's economy. The International Energy Agency (IEA) describes energy security as 'the uninterrupted physical availability at a price which is affordable, while respecting environmental concerns'. Energy security is therefore linked with availability of primary resources and people's easy access to these resources on the one hand and its sustainable development on the other. Sustainable development requires a pattern of resource use that aims to meet human needs by preserving the environment so that these needs can be met not only in the present, but also for generations to come. Therefore, sustainable development 'meets the needs of the present without compromising the ability of future generations to meet their own needs' (UN, 1987).

According to common sense of conventional economics, availability of natural resources should be a strong component of energy security. Countries such as the US, Canada, Australia, and Norway are rich in resources and are energy-secured. But an opposite scenario is also very marked. We will soon find that the availability of primary energy resources does not automatically lead to prosperity of a country. Moreover, for many countries, it may cause a 'corruption - underdevelopment – repression' trap. Even GDP growth rate, the traditional development marker, does not always have positive correlation with resource abundance.

Many natural resource-abundant economies tend to grow slower than economies without substantial resources. Growth-laggard countries, such as Nigeria, Zambia, Sierra Leone, Angola, are all resource-rich, while the countries known as Asian tigers, i.e., Korea, Taiwan, Hong Kong, and Singapore, are all resource-poor (Mehlum, 2005), but are growth-smart.

Resources and Development: A Diverse Scenario

Considering their diverse experiences regarding resources and development, countries can be divided into four groups.

Countries under group A include the USA, Australia, UK, France, and Germany. These countries have command over not only its own resources, also on resources in many other countries of the world in different ways. These countries have been the beneficiaries of colonial system, old and new. Also, these countries serve as hosts to big multinational companies that control the world's mineral resources[1]. A few mutually linked companies dominate the sector in many countries, while their ownership is limited to countries of origin. For instance, BHP Billiton and Rio Tinto are the two largest companies in coal. The host countries of these companies are 'Australia and UK' and 'UK and Australia', respectively.

---

[1] The largest oil companies in the world are called 'super-majors' and include Royal Dutch/Shell, BP, Total, ExxonMobil, and Chevron, Texaco. At another level, there are the "majors" such as Conoco Philips, Occidental Petroleum, and Unocal.

Group B includes China, Malaysia, India, Brazil, and Vietnam. These are growing economies, have good control over their own resources. They have developed national institutions, and now expanding overseas. In each of these countries state-run agencies play the principal role of managing ownership and making policies. In India, for instance, the Geological Survey of India, Mineral Exploration Corporation, National Exploration Corporation, National Remote Survey Agency, National Geophysical Research Institute, and Indian Bureau of Mines—along with Coal India—dominate the main functions of exploring, extracting and policy making in regards to mineral resources[2]. Foreign investment in these countries supplement, not undercut, domestic investment.

Group C countries fall into 'resource-curse' group. They include Sudan, Nigeria, Colombia, Afghanistan and many other countries. They have no command over their own resources. Most of these countries had been colonies for hundreds of years. After independence, they have been dominated by multinationals or centre countries and by the local repressive corrupt ruling class. FDI has actually increased in these countries, yet the type of this investment is such that it has neither created jobs nor has it encouraged capacity building or technical development at the local level.

The meaning and outcome of investment in a resource-cursed country and that of a (capital) host country are markedly asymmetrical. The world has witnessed the havoc wreaked by multinational capital—the wars and the bloodshed—to gain control over the earth's mineral resources. The recent episodes of this, as we have all seen, were staged in Afghanistan and Iraq (Fouskas and Gokay, 2005). The imperial powers have colonized knowledge, thought and skills while engaging corrupt dictatorships and their allies around the globe in maintaining the resource curse phenomena.

Group D countries are mostly from Latin America: Venezuela, Bolivia, Ecuador, Argentina etc. These countries had been in resource-curse group for decades, but successfully pulled themselves out of that trap in recent years. They made political changes through people's resistance against neo-liberal reform. Since then, they have been trying to build new direction

---

[2] See for details: http://meaindia.nic.in/indiapublication/mining.htm

G165769

of development by changing policies, revising international contracts, building new institutions. This group consists of nations that are struggling to come out of this hellish situation marked by poverty, bondage and violence. They have made efforts to free their lives and resources from the pillage, domination and the dictatorships of a few hundred years. The beginning of this trend to exercise people's rights over their own resources is not merely an economic breakthrough; it is also a forerunner of a new kind of freedom.

After discussing the diverse experiences and tragic episodes in many countries, the question remains: where does Bangladesh stand?

Resource Curse Model

The negative outcomes in oil- and mineral-dependent countries are referred to as the 'resource-curse' (Tsalik and Schiffrin, 2005). Natural resource abundance does hinder economic growth in countries that have 'grabber-friendly institutions', but does not do so in countries with 'producer friendly institutions' (Mehlum, 2005). Many countries that are rich in natural resources, 'exploit and squander their wealth to enrich a minority' while corruption and mismanagement leave the majority impoverished. According to the second Arab Human Development Report, released by the United Nations in 2003, high dependence on oil in parts of the Middle East has led to 'the over concentration of wealth in a few hands,' also 'faltering economic growth', and 'weakened the demand for knowledge' (Tsalik and Schiffrin, 2005).

There are many instances of growing repression and human right violations linked to mineral resource exploitation. Almost one third of India has been ruled by military, most of these 'troubled' areas are resource-rich[3]. In Nigeria, Shell pays local security forces that commit abuses in Niger Delta, Chevron recruited and transported Nigerian military and police who shot at and killed peaceful protesters from Chevron helicopters (1998 and 1999). Poet activist Ken Saro Wa was hanged for protest. In Myanmar (previously known as Burma), UNOCAL made contracts with Burmese military to provide security for Yadana pipeline; villagers are killed, raped, tortured, and forced to work building infrastructure (1994 – present). In Colombia, riot police were brought in to remove members of U'wa indigenous people resisting Occidental Petroleum's oil projects (late 1990s). There is an unending war against people in Colombia in the name of anti-drug operation. In Ecuador, 'the city of shell' in Amazon jungle, near Quito, is protected by military base. Saudi Arabia and many other Middle Eastern countries have been ruled by total autocracy for long. Repressive system has been common for decades in many countries (Muhammad, 2011; Perkin, 2006; Perkin, 2007). Despite rising unemployment and poverty, Saudi Arabia has made the highest single military contract (US$30 billion) with the US in December 2011[4].

---

[3] India is known as the largest democracy, but militarization and repression threatens human rights in several areas. Arundhati Roy writes regularly on military-corporate nexus and myth of Indian democracy. See, for example, (Roy, 2011).

Export and Perish

Export is an obvious part of any country's economic activity. But things appear different in different context, for commodities and market. Here we are talking about non-renewable resources explored from nature. Therefore export of non-renewable natural resources does not have same consequences with renewable or manufactured goods. It is very common to find arguments in favor of exporting mineral resources from peripheral economies. It is generally argued by corporate economists and policy makers that export of mineral resources would accelerate growth in these countries[5]. But there are many opposite instances. A study on countries with diverse experience concludes that, 'on average, countries which started the period with a high value of resource-based exports to GDP tended to experience slower growth during the following twenty years...' (Sachs and Warner, 1997). In Saudi Arabia, whose proven crude oil reserves remain the largest in the world, per capita income has plunged from $28,600 in 1981 to $6,800 in 2001, increased however again with high price of oil in 2008.

---

[4] Washington Post also adds that, 'The deal — outlines of which were disclosed to Congress last year — also calls for refurbishing 70 F-15s currently in Saudi Arabia's fighter fleet, as well as providing munitions, spare parts and training for Saudi pilots and air crews. The deal comes at a time when the Pentagon is considering supplying "bunker-buster" bombs and other munitions to another key gulf ally, the United Arab Emirates': http://www.washingtonpost.com/world/national-security/massive-us-saudi-arms-deal-seen-as-a-foreign-policy-security-and-economic-boon/2011/12/29/gIQATNWQPP_story.html

[5] For detail discussion on gas export debate, please see (Muhammad, 2004).

Nigeria has vast natural gas, coal, oil and renewable energy resources that could be used for power generation and industrialization. Nigeria has an estimated 187 trillion cubic feet (tcf) of proven natural gas reserves (BP, 2010) which makes them the ninth largest natural gas reserve holder in the world and the largest in Africa. It also has the largest oil reserve in the region. Multinational oil companies have been working in Nigeria for decades to explore and export energy resources to the US and Europe. However, the country is suffering from huge load shedding, poverty, unemployment and a very weak infrastructure. All the oil revenues did not seem to add to the standard of living at all. Between 1970 and 2000, the poverty rate increased from about one-third of the population to almost 70 percent of the population (Tsalik and Schiffrin, 2005).

Another study estimates that, the number of Nigerians living on less than a dollar a day raised to 61.2 percent in 2010 from 51.6 percent in 2004, although Nigeria's economy grew at an average 7.6 percent between 2003 and 2010. While the lucrative oil industry has fuelled growth since crude was discovered some 50 years ago, the sector's dominance 'has been a curse for the population'[6].

Few years ago *The Economist* (April 4, 2002) reported on Myanmar that, 'an energy rich country, Myanmar is now suffering the worst fuel shortage in the region. Its own citizens are starved of electricity, but the regime sells a steady stream of natural gas to neighboring Thailand. Yet this export benefit has not saved the public finances. Current reserves are estimated at no more than US$240 million - enough to cover only the next six weeks of imports. A shortage of foreign exchange has caused the black-market price of gasoline shoot up by 600% in less than a year'.

---

[6] (http://www.france24.com/en/20120219-oil-reliance-fuels-nigerias-poverty-say-analysts?ns_campaign=editorial&ns_source=RSS_public&ns_mchannel=RSS&ns_fee=0&ns_linkname=20120219_oil_reliance_fuels_nigerias_poverty_say)

Ecuador, another resource-rich country in Latin America, has similar experience. Since 1970, in the period of oil boom, the official poverty level grew from 50 to 70 percent, under or unemployment increased from 15 to 70 percent, and public debt increased from $240 million to $16 billion. Allocation for the poorest segments declined from 20 to 6 percent (Perkins, 2006).

Congo has a bloody and cruel history mainly because of its huge mineral resources. Seventy five percent of Congolese natural resources are currently owned by foreign companies. Despite having huge mineral resources, Congo now ranks 158 and 142 respectively in terms of per capita GDP and human development index[7].

FDI: the other story

Investment, local and foreign, is very crucial in any dynamic country. But terms and condition, i.e., quality of that investment matters. In conventional development economics, foreign direct investment from western countries and MNCs are shown as a solution to capital scarcity problem and seen as 'over-sure solution' for development needs and poverty alleviation in peripheral countries. Nevertheless sometimes partial recognition of some ground reality may be found, such as, 'Foreign direct investment may bring benefits, but it may also be overly capital intensive when there is surplus labor, or multinationals may present costs to the host country that mount over time and alter the cost-benefit ratio unfavorably' (Meier and Stiglitz, 2001).

We have already seen that, development in many countries take a distorted, sometimes destructive form because of high reliance on FDI in energy sector. According to a UN organization report, '66 percent of foreign investment in the 1990s went to the developing nations of Africa. It has increased to 87 percent during 2000-2005. Only Angola, Chad, Equatorial Guinea and Sudan, the four oil producing countries, received 56 percent of foreign investment' (UNCTAD, 2006). The report also noted that foreign investment in these developing countries was generally 'resource-seeking'. Therefore the type of this investment was such that it had neither created jobs nor had it encouraged capacity building or technical development at the local level. This sector was like an island where the ones who profit at the end of the day are the multinational companies.

---

[7] See for details: (http://www.dominionpaper.ca/articles/119).

In his well researched book, mining expert and author Roger Moody shows that, economic growth has in fact been slower in countries that are dependent on multinational companies for the exploration of oil and other mineral resources. These are the same countries, however, where a higher rate of political instability, poverty and violence exists. Drawing from examples around the world, Moody demonstrates how these companies have caused irreparable damage to the forests, jungles, water, and the environmental make up of many nations. Their records in safeguarding the environment and human rights have always been abysmal (Moody, 2007).

A study report on the relation between development and capability building and the availability of mineral resources concludes that many mineral-rich nations such as Zambia, Sierra Leon, Congo and Angola are far behind in economic development compared to nations that are weaker in terms of owning such resources (Journal, 2006). The study also finds that wealth becomes a curse in some countries. Tempted by the richness of the resources, the powerful groups effectively destroy democracy and relevant institutions in order to facilitate the looting of wealth.

A report titled "Fanning the Flames" compiled scenarios of human disasters in some developing countries caused by big mining companies including BHP and Rio Tinto from UK and Australia[8].

The Corporate Agenda

One should not ignore the fact that, for common property resources 'private property rights are difficult to define' and its 'exploitation by one imposes costs on others' in many cases people in general (Dashgupta, 1982).

---

[8] See for details: http://www.waronwant.org/Fanning%20the%20Flames+15142.twl.

After studying different country experiences, former chief economist of the World Bank (resigned in 1999) and Nobel laureate economist Joseph Stiglitz asserted that, 'a country that sells off its natural resources, privatizes its oil company, and borrows against future revenues, may experience a consumption binge that raises GDP, but the accounting framework should show that the country has actually become poorer.' He also said, 'in many developing countries, privatization is tantamount to selling the natural resources to foreign firms, since there are no domestic firms with the capital and skills necessary to undertake the task of extraction' (Tsalik and Schiffrin, 2005).

He also commented on the debate regarding gas resources in Bangladesh. He said, 'a country like Bangladesh, with limited reserves of natural gas, might want to exercise caution when selling its' gas, given that there is no other effective way of insuring itself against an increase in the price of energy over the long run' (Ibid). Stiglitz suggested the IFIs not to put undue pressure on countries to privatize their 'extractive industries'.

But the World Bank and allies have specific agenda for their intervention in energy sector in different countries. According to their official statement: 'The Bank's Oil, Gas, and Mining Policy division-through an integrated set of services, loans, technical assistance, guarantees and knowledge products-provides advice on legal, fiscal and contractual issues, regulation, sector restructuring, and privatization. These efforts help state-enterprises transition to the private sector –reducing the drain on the public sector, lowering costs of production, and providing a level playing field that encourages entrepreneurs to enter a competitive market' (WB, 2011a).

Clearly the Bank aims to push for privatization, which they believe would 'reduce the drain on the public sector' and 'lower cost of production' and 'providing a level playing field'. We would soon find totally opposite results in Bangladesh after following their prescription.

Privatization and FDI in Energy Sector: Bangladesh Experience

Immediately after independence, Bangladesh Mineral Oil & Gas Corporation (BMOGC) was created through the Presidential order 27 on March 26, 1972. The reconstituted Corporation was short named 'Petrobangla' through the ordinance 15 of 22 August, 1974[9]. Bangladesh Petroleum Exploration & Production Company Limited (BAPEX) emerged as a Company in June, 1989, is an integral part of the Petrobangla as Exploration Directorate[10].

It should be noted here that Petronas, the national agency for petroleum in Malaysia is as old as Petrobangla. While the former is now competing in the global market and becomes one of the 'new seven sisters', Petrobangla has been marginalized systematically to give space to local and global corporate interests.

First elaborate discourse by the World Bank on Energy sector of Bangladesh was made in 1982[11]. This report was based on the findings of the Energy Assessment Mission undertaken in October 1981. Similar reports were also issued at the same time for Indonesia, Mauritius, Kenya, Sri Lanka, Zimbabwe, Haiti, Papua New Guinea, Burundi, Rwanda, and Malawi.

Even though no scientific analysis was cited, the report assessed the size of the gas reserves of Bangladesh as 10 trillion cubic feet (tcf)[12]. The Bank considered this reserve as 'substantial, economically recoverable natural gas reserves'. They also discovered that, 'at present consumption levels this amount of gas would last for several decades'. The report then urged for a 'rapid and effective use of this major resource' as it could be a 'crucial element in alleviating the country's current payment's problems and enhancing its energy outlook' (WB-UNDP, 1982).

---

[9] For details see: www.petrobangla.org.bd. On 13 November 1976, through the ordinance 88, the importation, refining and marketing of crude and petroleum products and vested with newly formed Bangladesh Petroleum Corporation (BPC).

[10] See for details, http://www.bapex.com.bd

[11] The report was a product of the Joint UNDP/World Bank Energy Sector Assessment Program. It was kept secret in the same line with most of other reports of these agencies. It said, 'this document has a restricted distribution. Its contents may not be disclosed without authorization from the Government, the UNDP or the World Bank' (Front page).

[12] Later total reserve of extractable gas (proven and probable) in the country was estimated as 20.5 TCF. While the total reserve remaining now is 12 TCF, may increase up to 20 TCF with ongoing exploration by Bapex, demand of gas in next 50 years with 7% GDP growth rate is projected more than 150 TCF.

The report then suggested the means by which Bangladesh could take advantage of these resources. The Bank prescribed for reform and said, 'given Bangladesh's limited capability in mounting an exploration program on its own, it would need to make concerted efforts to secure the participation of foreign oil companies in this area' (Ibid). Moreover, it continued, since 'the supply of gas is likely to remain well in excess of Bangladesh's expected internal needs for a substantial period of time'. Therefore the report offered different export options include the following: 'a. export gas through a pipeline to India; b. export gas after liquefaction; and or c. attract export-oriented industries which are energy intensive e.g., methanol production and/or use natural gas as a feedstock'. Later during the late 90s the World Bank and its allies reduced the list to only one option: export gas through a pipeline to India for the 'bright future'.

Similar report and recommendations were found from the Asian Development Bank (ADB). They proceeded with a major energy study and an update of the power sector master plan in the same year as the World Bank (ADB, 1982). Its report was more specific in recommending 'most effective use of gas resource'. The report stated that, 'a potentially important possibility is that India might be the logical (most remunerative) customer for any gas which Bangladesh decides to export as such. A pipeline to the Calcutta area could prove to be the most efficient way to get gas to this major market. The possibility of gas sales was studied by a British consultant who found that it could be feasible' (ADB, 1982).

A similar direction was set for the power sector. How the Government, Rural Electrification Board (REB) and Palli Bidyut Samity (PBS), came into terms and where the World Bank and its IDA stand in the process is a matter of importance to understand the 'development' in Power sector. Both REB and PBS were born through earlier projects of these agencies (Muhammad, 2003).

In October 1996, as a follow-up of similar other projects, the Government of Bangladesh approved a 'private sector power generation policy' (PPGP). Its essence was that new power generation capacity would be created through multinational corporations in power sector usually called as Independent Power Producer (IPP). And the new power generators would be constructed on a Build- Own- Operate (BOO) basis. Four public sector power generation

CALCUTTA CENTRAL LIBRARY UNIVERSITY

projects (Barapukuria coal based, Shahjibazar, Baghabari, Sylhet gas turbines) were also asked to postpone and to be carried out through IPPs[13].

As a result, foreign direct investment increased dramatically since early 90s. New contracts were being signed with foreign companies in gas, telecommunication and electricity sectors. According to the World Bank estimates, since 1996 the annual averages of the highest capital inflows of FDI took place in gas sector followed by power sector in 5 years time. FDI in EPZ remained comparatively much lower (WB, 1999). Although telecom showed small figure in the beginning, FDI inflow in that sector alone has shown substantial increase in the later years.

In 1993-94, six production sharing contracts (PSCs) were signed in the first round. Cairn Energy-Holland Sea Search was awarded Block 15 and 16. Later Halliburton/Santos took Block 16, and Shell/Cairn -Block 15. Initially, Occidental got Block 12, 13 and 14, later transferred to Unocal and again these blocks were transferred to Chevron. Block 17 & 18 was awarded to Oakland-Rexwood, later Oakland/Tullow. United Meridian Corporation got Block 22. In 1997, four PSCs were awarded in second licensing round. Shell-Cairn Energy was awarded Block 5 and 10, Tullow-Chevron-Texaco: Block 9; Unocal, later Chevron got Block 7, Bapex is tagged with these companies with little share. According to these contracts, the country started purchasing its own gas initially by at least 30 times more price than the public sector companies were providing, with hard earned foreign currency.

Policy was taken to bring International Oil Companies (IOC) or multinational company (MNC) to explore gas when BAPEX, the national exploration agency, had the ability to do the same. Gas rich blocks in eastern side were awarded for IOCs. Common property has been turned into private property. Instead of reducing as claimed by the World Bank, this privatization increased public money drainage significantly. According to the Bank, 'Petrobangla buys gas from IOCs at a price linked to the international price of fuel oil. Petrobangla will incur increasing deficits, leading to a negative cash flow' (WB, 1999).

After working long to pave the way for these foreign direct investments, in 1999, the World Bank stated that the nature of foreign direct investment 'has implied little augmentation of foreign exchange reserves', because, 'the bulk of FDI in the power sector so far is made up of imports (e.g. pre-fabricated barge mounted power plants); so are capital costs of IOCs engaged in the gas sector, and much of the foreign investment and lending in the telecom sector finance imports of telecommunications equipment' (WB, 1999).

---

[13] For details discussion on the role of IFIs in Bangladesh, see, (Muhammad, 2003; Muhammad, 2008).

The World Bank, therefore, made it clear that, 'the import intensity of FDI inflows and subsequent profit repatriation and interest payments imply a worsening current account deficit associated with FDI' (Ibid). According to the Bank's estimates, foreign direct investment inflow was much less than the outflow spent in foreign imports related to the projects. The further projection was that it would grow further. In order to understand causes behind World Bank's unusual recognition of adverse effects of foreign direct investment in Bangladesh one has to go further to read their suggestion: 'there is no discernible accumulation of foreign exchange reserves in the absence of gas exports' (Ibid).

Asian Development Bank also recognized the new problem and said, 'although the individual companies responsible for ADB-financed gas sector projects are profitable, Petrobangla is incurring losses due to the increasing share of more expensive gas from IOCs'[14]. Therefore solution according to the WB and ADB was very specific: a. to solve the fiscal deficit, raise gas price b. to solve the pressure on foreign currency, export gas. Therefore, the prescription that was offered in 1982, i.e., export of gas, appeared as a compulsion in 1999; periodic increase of gas and electricity price has become urgent necessity. Governments proceeded accordingly. Huge campaign began in 1999 in favor of gas export plan (from Bibyana Sylhet to India) placed by US company Unocal. The then US president Bill Clinton visited Bangladesh in March, 2000 visibly as a part of that campaign.

But independent experts and people in general stood against this[15]. Facing peoples protest against PSCs and gas export, the government formed two committees in 2002. One committee was formed to analyze reserve situation, another was for best utilization. Committee on utilization, after analyzing all relevant facts, concluded against export and said, 'involving the multinational oil companies in the country's domestic gas market has drawn only negatives' (Report, 2002).

---

[14] http://www.adb.org/Documents/Reports/SAPE/BAN/SAP-BAN-2009-36/SAP-BAN-2009-36.pdf)

[15] A people's long march from Dhaka to Bibyana in March 2002 played a significant role to force government to revise its decision.

Development of Burden

All relevant facts show that by leasing out most resource- rich gas blocks to IOCs, Bangladesh becomes hostage. Cost of production of gas and electricity, therefore, fiscal burden has been increased in a linear rate. Instead of saving public money, drainage and corruption increased manifold. In the last 10 years multinational oil companies received 160 billion taka by selling gas to Bangladesh, which could be purchased by 20 billion taka from public sector companies in local currency (Mostafa, 2010). Drainage of foreign currency equivalent to 140 billion taka in few years is, therefore, a direct outcome of FDI in gas sector alone. This amount is more than the budget allocation in energy sector for the last three years.

Two arguments have always been made to construct myth to bring MNCs in Energy sector, (a) countries like Bangladesh lacks necessary capital, FDI would fulfil this scarcity; and (b) the country lacks technical ability, MNC would provide efficient and latest technology. Like many other peripheral countries, facts and figures show otherwise. In Bangladesh case, these are as follows:

1. Privatization and bringing in MNCs in energy sector has increased public expenditure instead of 'reducing drainage of public resources' as claimed by the IFIs. For example, at least one 500 MW power plant could be built every year by the money spent, about 25 billion taka, as subsidy for purchasing gas from MNCs. It is increasing as their share is growing.
2. When Bapex-Petrobangla spends Tk. 1 billion to drill a well, MNCs usually do it by costing 2 to 6 times (Mostafa, 2010). This is far from the argument made that MNC is more efficient and would reduce cost of production.
3. When MNCs selling gas at $3-$4 per thousand cft (MMCF), Bapex could give it at 25 percent price.
4. Governments have been periodically increasing gas and electricity price to reduce subsidy caused by increasing MNC share. Rising cost of production and cost of living an obvious outcome.

5. Bangladesh lost 500 bcf gases due to blow-out in Magurchhara (1997) and Tengratila (2005). This amount of gas equals gas used for power generation in 20 months for whole of Bangladesh in 2011.
6. Compensation due from US company Chevron and Canadian company NICO still unrealized. The price of the gas lost is more than 5 billion US dollar, which is nearly 8 times of average yearly budget allocation for energy sector. No government since 1997 has taken any step to realize the compensation. On the contrary, reports reveal their opposite role[16].

It is also not surprising that the WB, ADB or other IFIs who used to be very vocal about everything but collectively remain silent about this compensation issue.

Therefore all facts make it clear that the World Bank's claim about the benefit of privatization and FDI in energy sector proved wrong and their move proved to be fraudulent.

USA lobby and the Contract with Conoco-Phillips

Recently Wiki leaks revealed the US lobbying in Bangladesh for US corporate interests. In fact, US involvement in lobbying, conspiring, pressurizing peripheral governments for ensuring corporate interest especially in energy sector has been well known. There are sufficient evidence to show that the US empire can go up to killing people, can lead bloody political change, back autocrats, occupying land, genocide to protect big business (Blum, 2003). US embassies do a lot in this regard.

Let me give another example to show their lobbying in public. Months before 2001 general election the then US ambassador Mary Ann Peters suggested a five point economic action plan from the new government in their first 100 days, in 'honeymoon' period as she called. She explained her position in a speech titled 'Accelerated growth: a challenge for the new government' delivered at the monthly luncheon meeting of the American Chamber of Commerce in Bangladesh (AmCham) in Dhaka on 15 May, 2001. She insisted in her speech for a. implementing agreement between the government and Stevedoring Services of America (SSA) on a nearly $450 million project should be signed quickly[17], and b. gas should be exported to India for maximum return[18] among others[19].

---

[16] 'Prime ministers had been seen interfering in the operations of the [parliamentary] standing committees on several occasions. For instance, the Daily Star reported (January 5, 2001) that the original committee report prepared in 1997 on the Magurchara gas field blowout was not submitted to the parliamentary committee on Energy at the suggestion of the former Prime Minister Sheikh Hasina. She was in charge of the energy portfolio. The officials of the US oil company, Unocal (formerly Occidental) responsible for the blowout, incurring huge financial and environmental loss for the country, did not appear before the committee, which was backed by the former Prime Minister [Shiekh Hasina]. Moreover, the immediate past Prime Minister, Khaleda Zia had been seen holding talks with chairmen of different committees and instructing them not to criticize ministers and deliberate corruption-related issues in the committee meetings, which could damage the images of the government' (Rahman, 2008).

A decade later, Wiki leaks exposed US embassy's lobbying activities in private too. It was found that, the 'US diplomats privately pressurized the Bangladeshi government into reinstating a controversial coal mine which had been closed following violent protests'. Report on the leaked notes reveals that, 'later on in the cable, Moriarty privately noted: ''Asia Energy, the company behind the Phulbari project, has sixty percent US investment. Asia Energy officials told the Ambassador that they were cautiously optimistic that the project would win government approval in the coming months."' Cable also made it clear that, 'Energy Adviser agreed to build support for the project through the parliamentary process'[20].

Another report, quoting US diplomatic cables leaked by Wiki leaks, added that the US ambassador persuaded the government in July last year to award two blocks in the Bay of Bengal to Conoco Phillips and to permit Chevron to set up a compressor in Muchai[21].

---

[17] On the public pressure it was investigated, legally challenged and later found that whole procedure of the project was not sound, legally flawed and that was stopped by the Court.

[18] People's resistance stopped US company's plan to export of gas. Otherwise it would create a long term disaster.

[19] Anu Muhammad: 'US ambassador's "honeymoon" proposal for Bangladesh, FDI and our agenda', published in *Daily Star* as a response to the Ambassador's 'agenda for action', May 28, 2001, (Muhammad, 2007). US ambassador did not respond.

[20] http://www.guardian.co.uk/world/2010/dec/21/wikileaks-cables-us-bangladesh-coal-mine

[21] http://www.bdinn.com/news/conoco-phillips-chevron-contracts-pm%E2%80%99s-adviser-us-envoy-agreed-deals- wikileaks/

On June 16, 2011 two oil gas blocks in the Bay of Bengal leased out to the above mentioned Conoco Phillips. Independent researchers and public bodies expressed their main concern as follows:

1. 80 percent (effectively 100 percent) export opportunity for Conoco-Phillips (15.5.1 Subject to Articles 15.5.4, 15.5.5 and 15.6).
2. Bangladesh share is given 'not more than 20 percent' (15.5.4). Moreover, the country will have to build its own pipeline to bring its share to onshore.
3. Production limit is relaxed (to more than 7.5 percent).
4. Joint Review committee and management committee are dominated by Conoco Phillips.
5. Conoco Phillips has bad records for blow-out in other sea blocks; nevertheless compensation conditions are not concrete.
6. Authority over Bay of Bengal is crucial for Bangladesh. That is being threatened[22].

There had been strong protest against this, including two general strikes by the people before and after signing the contract.

Coal: New Frontier

So far, Bangladesh has five coalmines with approximately 3 billion tons of coal reserves. In coal mining, Bangladesh is comparatively new and yet to start mining in a big way. Since early 1990s, big mining MNCs started exploring business potentials. Geological Survey of Bangladesh (GSB) discovered Barapukuria coal mine in 1985, it was the first discovery that was feasible for mining. It went into operation under Petrobangla, the national agency, with a Chinese contractor in 2004.

---

[22] These are compiled from (Petrobangla, 2011).

Coal mines in Bangladesh

Year of Discovery	**Location**	**Depth (meter)**	**Reserve (million ton)**	**Comment**
1962	Jamalgan, Joypurhat	640-1158	1050	Too deep to be technically feasible in the foreseeable future.
1985	Barapukuria Dinajpur	130-506	390	Production since 2005, owned by Petrobangla, operated by Chinese company. Land slide and water logging
1989	Khalashpir	257-482	685	Project submitted for mining
1989	Dighipara	328-407	500	Reserve yet to be confirmed
1997	Phulbari, Dinajpur	150-240	572	Open pit mine was planned by a mysteriously formed new mining company. It was rejected by both experts and people in general. Three people were killed and hundreds were injured in resistance gathering on 26 August, 2006.

The Bangladesh Government originally awarded an exploration license for Phulbari coalmine in 1994 to the Australian company BHP Minerals. In 1997 Asia Energy was formed and in 1998 BHP transferred its license to this newly formed company, incorporated in London Stock Exchange Alternative Investment Market. Asia Energy changed its name to Global Coal Management after August-2006 uprising and bloodshed in Phulbari. Its major shareholders are Polo Resources USA, RAB Capital, UBS, Fidelity Group, Barclays, Credit Suisse, LR Global, Ospraie Management, Capital Group and Argos Greater Europe Fund. With only 6 percent royalty for Bangladesh, 75-80 percent of the coal was planned for export through Sundarban mangrove forest.

This project faced huge resistance first by local community, then by national organization for safeguarding national interest and environment. There was a huge demonstration on August

26, three people were killed and hundreds were injured by firing from semi military (BDR) forces. Peoples uprising spread all over the country and government was compelled to sign an agreement on August 30[23]. 'Phulbari Agreement' (as it is known) was signed between the government of Bangladesh and the agitating people[24] (August 30, 2006). The main points of the agreement were:

1. 'Phulbari coal project will be scrapped and Asia energy will be ousted from the country.'
2. 'No open pit mining will be allowed anywhere in the country'.
3. 'Mining method and other steps for coal development and utilization will be taken after proper consultation with the people, keeping national interest in tact'.

Main reasons for strong opposition to open pit mining, foreign ownership, and export, include:

1. About 200,000 people from 150 villages will have to be evacuated from only one mine area.
2. De-watering in the mining area will not only disturb the major aquifer, it will also damage the most potential and massive aquifer of north-western Bangladesh, making the area a desert-like place.
3. Huge area outside the mining area will be affected through groundwater depletion that currently provides a significant portion of the country's food supply. Open pit mine Project would therefore have serious impacts to the nation's food security and environment.
4. After destroying food and human security for extracting coal, energy security would also be destroyed by exporting coal.

---

[23] For details of this uprising, series of events and theoretical position see (Muhammad, 2006; Muhammad, 2007).

[24] National Committee to Protect Oil Gas Mineral Resources Port and Power represented the people.

An expert committee, formed by the then government, also gave their opinion against the project and termed it as legally flawed, environmentally disastrous and economically against national interest (Islam, 2006).

However, all the people's resistance, Phulbari agreement and expert committee's recommendations could not stop lobbying for the project by the vested local and foreign interest-groups. We have already seen the role of US embassy in Dhaka. British high commission was not exception; evidence is there even in British parliamentary proceedings. Gareth Thomas, UK Minister for International Development and Business stated in a parliamentary answer in April 2008 that, 'We have provided support to Global Coal Management Resources PLC, through the British high commission in Dhaka. They have lobbied to ensure that the Government of Bangladesh take the company's interests into consideration and do not prohibit opencast mining. The British high commission will continue to remain in touch with the company and will represent their interests as appropriate. The Bangladeshi Caretaker Government's new draft coal policy leaves the way open for opencast mining in Bangladesh in the future'[25].

Nevertheless, people's resistance has been strong enough still today to confront global alliance hungry for Bangladesh coal.

Bangladesh: Challenging the Model

In fact, Bangladesh started well during the early 1970s, later it got embedded into neo-liberal (conservative) development paradigm and was destined to become another resource cursed country. Privatization of natural resources, handing over it to MNCs, projects of exporting gas and coal and open pit mining actually tried to set Bangladesh into resource curse model. The model was pushed unitedly by local and global alliance consisting of the MNCs, governments of the US, UK, Germany, Australia and the World Bank, ADB.

Although this approach still remain strong, collective efforts by experts, academics and activists during the last twelve years made a resistance to the trajectory set by them.

---

[25] http://www.publications.parliament.uk/pa/jt200910/jtselect/jtrights/5/5we19.htm

Resistance during 1999-2004, against gas export by depriving people and the economy, Phulbari uprising and national resistance in 2006 against Phulbari coal project, and continuity of that resistance (latest long march 24-30 Oct, 2010), peoples tribunal against World Bank, IMF and ADB (2008), protest against gas deal with Conoco Phillips since 2008 (including two general strikes in 2009 and 2011), have brought issues related to energy security and sustainable development in peoples thinking and actions[26].

These counter hegemonic efforts have created a large consensus in public opinion against anti-people corrupt deals, and therefore, in favor of utilizing natural resources for its own people and the economy. The people's consensus therefore emerged on the following issues:

1. People of the country should have 100 percent ownership and authority over its own resources.
2. Neo liberal development paradigm should be replaced by people centered development policy.
3. IFIs disastrous policies should be rejected make them accountable, and their immunity should be scrapped.
4. Food and Energy should be the priority. No destruction of agricultural land and no export of energy can be allowed considering urgency of food security as well as energy security.
5. No development project is acceptable that destroys people's lives, livelihoods and environment.
6. People's consent and participation in ensuring long term sustainability must be part of the development process.
7. More efforts should be given to explore huge potential of renewable energy.

t needs to be mentioned that, infinite supply of solar power and wind for power generation vailable all over the year in Bangladesh. Cost is still comparatively high, research and nnovation in right direction along with right institution will soon make it cheaper.

---

[6] National Committee to Protect Oil Gas Mineral Resources Port and Power has been actively involved in nobilizing public opinion against corrupt anti-people deals since 1998, which is a large combine of political arties, academics, experts, students, ethnic minorities women and men.

Conclusion

Bangladesh has neither been a resource abundant country, nor a resource poor country ever. It has resources in many dimensions: fertile land, underground and surface water, rich biodiversity and human resources. Although limited yet crucial to achieve energy security Bangladesh has mineral resources like natural gas and coal. It has abundant sun and wind too a source of infinite renewable energy. But this country still lacks political will and institutiona set up to be capable of utilizing its own resources in a way that best serves its' people an environment.

Global capital is in confrontation with people all over the world, among others, on thre issues: a. should the people and the country own and have authority over their own lives an natural resources or global corporations should be allowed to take over; b. should the natura resources be used or preserved for the development of the country or to be extracted in a bi way to maximize profit of MNCs and their junior partners; and c. should the resources remai as common property or turned into private properties of corporations. Like many othe countries Bangladesh has been struggling on this since 1990s.

Global experiences teach us that energy sovereignty is the key to national sovereignty, securit and development in real sense. Therefore our conclusion is obvious. Countries lik Bangladesh has no other option but to make fundamental changes in the approaches c development to come out from the 'resource-curse' model to survive, to develop and to ensu energy security for sustainable development.

References:

Asian Development Bank (ADB), Annual Report (1982) P. 65.

ADB (2008) Peoples Tribunal, http://www.apwld.org/archive/adb_judged.html

Blum, William (2003) *Killing Hope: U.S. Military and CIA Interventions since World War* revised edition.

BP (2010) *Statistical Review of World Energy.*

Dashgupta, Partha (1982) *The Control of Resources,* Cambridge.

Fouskas, K. Vassilis; Bulent Gokay (2005) *The New American Imperialism: Bush's War on Terror and Blood for Oil,* UK.

GOB (2011) Government of Bangladesh: *Bangladesh Arthanoitik Shameekkha.*

Islam Nurul (2006) "*Report of the Expert Committee (REC) to Evaluate Feasibility Study Report and Scheme of Development of the Phulbari Coal Project, submitted by Messieurs Asia Energy Corporation, (Bangladesh) Pvt. Ltd. (AEC) in Bangla", September.* Summary of the report is available in English in: http://meghbarta.info/development-and-policy/6-development-and-policy/78-summary-of-the-report-of-the-expert-committee-rec-to-evaluate feasibility-study-report-and-scheme-of-development-of-the-phulbari-coal-project-submitted-by-messieurs-asia-energy-corporation-bangladesh-pvt-ltd-aec-.html.

"*Institutions and the Economic Growth*" (2006*) Economic Journal*, Royal Economic Society.

Mehlum, Halvor; Moene Karl; Torvik Ragnar (2005) *Institutions and the Resource Curse.*

Meier, Gerald M.; Joseph E. Stiglitz, (ed) (2001) *Frontiers of Development Economics,* World Bank.

Moody, Roger, (2007) *Rocks and Hard Places: the Globalization of Mining*, Zed Books. London.

Mostafa, Kollol; Rubaiyat Mahbub; Saikat Shanto Anupam (2010) *Jatiyo Sampad, Bohujatik Punji o Malikanar Torko*, Sanghati.

Muhammad, Anu (2003) "*Bangladesh's Integration into Global Capitalist System: Policy Direction and the Role of Global Institutions*", in Matiur Rahman (ed) *Globalisation, Environmental Crisis and Social Change in Bangladesh,* UPL, Dhaka.

Muhammad, Anu (2004) "*Foreign Direct Investment and Utilization of Natural Gas in Bangladesh*" in http://www.networkideas.org/featart/jul2004/fa26_FDI_Gas.htm.

Muhammad, Anu (2006) '*Phulbari and the people's verdict*', http://www.thedailystar.net/2006 /09/24/d609241501130.htm.

Muhammad, Anu (2007, 2011) *Development or Destruction, Essays on Global Hegemony, Corporate Grabbing and Bangladesh,* Sraban.

Muhammad, Anu (2007) *Phulbari, Kansat, Garments 2006* (Mass uprising in 2006), Sraban.

Muhammad, Anu (2008) *Kothai Jachche Bangladesh,* Sanghati.

Perkins, John (2006) *Confessions of an Economic Hitman,* UK.

Perkins, John (2007) *The Secret History of the American Empire,* US.

Petrobangla (2011) '*Model Production Sharing Contract 2008*' and briefing note by Petrobangla on the contract with Conoco Philips, June 16.

Rahman, Taiabur (2008) *Parliamentary Control and Government Accountability in South Asia: A Comparative Analysis of Bangladesh, India and Sri Lanka*, Routlege, London.

Ahmed, Azimuddin (2002) *Committee Report on Utilization of Natural Gas in Bangladesh*, prepared for the Government of Bangladesh.

Roy, Arundhati (2011) *Walking With The Comrades,* Penguin.

Sachs, Jeffrey D.; Andrew M. Warner (1997) *Natural Resource Abundance and Economic Growth*, HIID, Harvard University, November.

Tsalik, Svetlana; Anya Schiffrin (2005) *Covering Oil,* Open Society Institute, edited.

UN (1987) *Our Common Future, The Brundtland Commission, formally the World Commission on Environment and Development (WCED) report*, United Nations.

UNCTAD (2006) *The Least Developed Countries Report.*

UNDP (1982) *The Joint UNDP/World Bank Energy Sector Assessment Programme and Energy Sector Management Programme: A Progress Report*, United Nations Development Programme, World Bank, United Nations Development Programme, World Bank.

WB (2011) World Bank: World Development Indicators, Internet, accessed 6.9.11.

WB (1999) World Bank: *Foreign Direct Investment in Bangladesh: Issues of long run Sustainability*, October.

WB (2011) a, (http://web.worldbank.org/WBSITE/EXTERNAL/ TOPICS/ EXTOGMC /0, me nuPK: 63288~contentMDK:20219974~pagePK:148956~piPK: 216618~ the Site PK : 336 93 0 , 00.html).

Section A

Salient features of Environment and Resource Management in Bangladesh and West Bengal

Sub-section 2: West Bengal

Integrated Environmental Pollution Control Strategies in West Bengal

S.C.Santra*

Abstract

Environmental pollution is a major threat to our present society. So, to control it and to ensure safety of public health some measures are taken. With reference to West Bengal various activities are taken up by the Pollution Control Board of West Bengal (WBPCB). These activities not only include environmental quality monitoring but also the initiatives to control pollution in the state. As a matter of fact, several policies have been laid down for industries in West Bengal and surveillance of those industries is done on a regular basis to check pollution. The regulatory role of WBPCB plays a major role to bring awareness about the effects of pollution on the environment and also to control pollution. Finally, the paper highlights it is the citizens and the regulatory agencies who should participate jointly to meet the threat named 'Environmental Pollution '.

Introduction

Environmental pollution is one of many concern of our present society. There is a great need for understanding its sources, magnitude of the problem and its consequence analysis and control. The pollution of air, water, and noise on public health has direct impact, while the pollution of soil has a long term indirect impact. Since the recognition of various kinds of pollution problems, a wide range of strategies are adopted for pollution control. Source identification, monitoring and control were the principal options of pollution control where pollutants arising out of point sources, while non-point source pollutants or unidentified pollutant sources are difficult to manage. Since 1970s, various legislative measures were undertaken for control of pollution from diverse sources through a regulatory agency i.e. state Pollution Control Board. Various kinds of technological innovation are also made for regulating industrial and automobile pollution in particular. Alter fuel use pattern, recycle and reuse of waste in the processing, and strict vigilance of emission and discharge guidelines are the major goal for environmental pollution control. Though environmental pollution is local problem, but its significant relevance lies in regional and global scale. For instance fossil fuel use heads to higher CO_2 level in troposphere and thus induces global warming and climate change.

---

*Professor, Department of Environmental Science, University of Kalyani, India.

The West Bengal Pollution Control Board was constituted along with a few other State Pollution Control Boards (SPCB) in the year 1974, under the provisions of the Water (Prevention, and Control of Pollution) Act 1974. This board is a statutory authority for abatement and control of Pollution within the territorial jurisdiction of the state of West Bengal. Currently SPCB is entrusted to perform various responsibilities relating to pollution control as laid down in 14 major rules/Acts.

- The Water (Prevention and Control of Pollution) Act, 1974, as amended to date
- The Water (Prevention and Control of Pollution) Cess Act, 1977, as amended to date
- The Air (Prevention and Control of Pollution) Act, 1981, as amended to date
- The Environment (Protection) Act, 1986, as amended to date
- The Hazardous Wastes (Management and Handling) Rules, 1989, as amended to date
- The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989, as amended to date
- The Biomedical Wastes (Management and Handling) Rules, 1998, as amended to date
- The Recycled Plastics Manufacture and Usage Rules, 1999, as amended to date
- The Municipal Solid Wastes (Management and Handling) Rules, 2000
- The Noise Pollution (Regulation and Control) Rules, 2002, as amended to date
- The Ozone Depleting Substances (Regulation and Control) Rules, 2000
- The Batteries (Management and Handling) Rules, 2001
- Environmental Impact Assessment Notification, 2006, as amended to date
- The Public Liability Insurance Act, 1991, as amended to date

Activities of the Pollution Control Board, West Bengal

The section 17 of both the Water (Prevention and Control of Pollution) Act, 1974 and the Air (Prevention and Control of Pollution) Act, 1981 have clearly spelt out the legally mandated responsibilities of the State Pollution Control Boards as detailed below:

- To plan comprehensive programme for the prevention, control or abatement of water and air pollution in the state and to secure the execution thereof;
- To advise the State Government on any matter concerning the prevention, control or abatement of water and air pollution;
- To collect and disseminate information relating to water and air pollution, and the prevention, control or abatement thereof;
- To encourage, conduct and participate in investigations and research relating to problems of water pollution and prevention, control or abatement of water pollution;
- To collaborate with the Central Board in organizing the training of persons engaged or to be engaged in programmes relating to prevention, control or abatement of water and air pollution and to organize mass education programmes relating thereto;
- To inspect sewage or trade effluents, works and plants for the treatment of sewage and trade effluents and to review plans, specifications or other data relating to plants set up for the treatment of water, works for the purification thereof and the system for the disposal of sewage or trade effluents or in connection with the grant of any consent as required by the Water Act;
- To inspect, at all reasonable times, any control equipment, industrial plant or manufacturing process and to give, by order, such directions, to such persons as it may consider necessary to take steps for the prevention, control or abatement of air pollution.

On the Whole major activities of the State Boards are as follows:

- Environmental quality monitoring
  - Air quality monitoring
  - Water quality monitoring
  - Noise monitoring

- Industry specific pollution control
- Automobile pollution control
- Implementation of environmental impact assessment & environmental clearance at state level.
- Management of classified wastes,
- Research activities in frontier areas of environmental concern,
- Environmental governance
- Environmental awareness programs
- Capacity building of board personnel
- Linkage with externally aided projects /agencies.

To maintain the clear image of the state, board implemented the provision of Right to Information Act 2005 relating to all major activities of board. In the year 2008-09, the board has received 99 applications as RTI case and all are disposal off with appropriate reply.

Environmental Quality Monitoring

- **Air Quality**

The West Bengal Pollution Control Board has been regularly monitoring ambient air quality of major towns and industrial areas of the state through a large network of monitoring stations using manually operated Respirable. Dust Samplers. These stations operate throughout the year. During the year 2008-2009, the Board monitored air quality at 28 stations [Kolkata (18 stations), Howrah (4 stations), Haldia (2 stations) and Durgapur-Asansol region (4 stations)]. But in the year 2009, the air quality monitoring network has been further strengthened by increasing the number of such stations from 28 to 46. At present, air quality is monitored at these 46 stations for the criteria pollutants like Suspended Particulate Matters (SPM), Respirable Particulate Matters (RPM), Sulphur Dioxide (SO_2) and Nitrogen Dioxide ($N0_2$). These stations operate on two days a week for 24 hours in each day of monitoring. Out of these 46 stations, 34 stations are under the National Air Monitoring Programme (NAMP) and the rest 12 stations are under State Air Monitoring Programme (SAMP). The data generated through these stations are uploaded in the website of the State Board. The data generated in the NAMP stations are also uploaded regularly in the Environmental Data Bank of the Central Pollution Control Board.

- **Monitoring of River Water Quality**

Water quality monitoring performed by the West Bengal Pollution Control Board is for the defined purpose of "..... The prevention and control of water pollution and the maintaining or restoring of wholesomeness of water...." as indicated in the Water (Prevention and Control of Pollution) Act, 1974. The objective of water quality monitoring is to obtain quantitative information on the physical, chemical, and biological characteristics of water via a defined sampling and accurate analysis programme to depict the state of the system, i.e., the quality status of the water of the water body system monitored. The type of information sought depends on the objectives of the monitoring programme. Usually the objectives and purposes of any monitoring programme range from detection of drinking water standard violations to determination of the environmental state and analysis of temporal water quality trends.

- **Monitoring of Lakes**

Natural lakes, sweet water reservoirs and ponds are turning out to be extremely important surface water sources considering the looming water crisis. The West Bengal Pollution Control Board, until recently, used to monitor the only large such lake, the Rabidrasarover in Kolkata considering its being a lake of national importance. With more and more dependence on lake water to cater the following needs, eight new lakes/reservoir/pond water stations were created by CPCB under National Water Quality Monitoring Programme (NWMP).

- **Monitoring of Ground Water (Tube Well, Bore Well, Hand pump)**

The most stressed sweet water reserve in our Country is the ground water reserve. Contamination in Groundwater most often occurs due to geo-hydro chemical processes activated by indiscriminate pumping out of the pristine reserve. The ground water Arsenic contamination in around nine districts of the State is believed to be one such catastrophe. Once contamination starts, very little can be done to check it except a total ban on withdrawal of water from the contaminated aquifer and sealing the tap outlets. And it takes a long - very long time for the water quality to revert back to the level that can be consumed directly. Underground water being a soft source to tap for human consumption is very difficult to maintain. Millions of families in India depend on groundwater for sustaining irrigated agriculture and livelihoods. Uncontrolled urbanization has an extreme adverse impact on groundwater. Fast depletion of ground water is a common phenomenon in urban India and things worsen with improper planning and implementation of water budgeting, land use and management of industrial effluent and domestic waste water disposal system.

Noise pollution is a fast growing environmental issue which has become a great nuisance to our society these days. During the present age of modernization as well as industrialization, noise causes detrimental effect upon environment and affects the overall quality of life by imposing both physiological and psychological effects on human-beings. Apart from noise induced deafness, it affects human activities and mental abilities resulting into low productivity, efficiency, accuracy and safety. Beside, proper monitoring and control of the noise at its source there is need to create general awareness regarding the hazardous effects of noise pollution to reduce its ill effects on human and its natural environment.

On the basis of this notable fact, West Bengal Pollution Control Board has taken up several effective initiatives during 2008–09 and 2009–10 like previous years. Such initiatives ranges from conducting noise pollution as road traffic noise survey in some selected locations of Kolkata.

- **Road Traffic Noise Pollution Survey at Kolkata Metropolis**

Like previous years, the State Board has conducted detail survey on noise pollution within Kolkata Metropolis during both the period of 2008-09 and 2009-10. This survey work aims to generate a dependable time series data base on noise level. For this survey ten (10) monitoring locations were selected in residential/silence zone area adjacent to major roads in Kolkata. These locations are:

1. Shyambazar
2. Ultadanga
3. Bowbazar
4. Moulali
5. Girish Park

6. Park Street
7. Hazra More
8. Kidderpore
9. Gariahat
10. Taratola

Noise level monitoring was conducted at these locations using B & K 2238 Type I Sound Level Meter, placed on a tripod strand at a height of 1.2 m from the ground level along with the dry and wet bulb temperatures, traffic count, honking of horn for 24 hours at each locations.

Environmental Clearance

The Environmental Impact Assessment procedure for large industrial/ developmental projects was thoroughly restructured in 2006 through issuance of Notification S.O. 1533 (E) on 14th September 2006 by the Ministry of Environment & Forests (MoEF), New Delhi. The major objective of this restructuring of EIA procedure was to decentralize the process from National level to State level and also to bring transparency and speed in the mode of disposal of Environmental Clearance applications.

Under this new EIA procedure the Public Hearing process was also modified through expanding the Public Hearing to Public Consultation procedure. However, like previous regime the role of West Bengal Pollution Control Board remains pivotal in this new public consultation process.

The new trends and outcome which emerged from organizing public hearing by West Bengal Pollution Control Board (WBPCB) and functioning of SEIAA-SEAC for State Level Environmental Clearance procedure under new regime are described in two following articles of this chapter:

A. Public Consultation Procedure in West Bengal after September 2006 and its social out come

B. Introduction of Environmental Clearance procedure at State Level in West Bengal and its social outcome.

A. Public Consultation Procedure

The West Bengal Pollution Control Board conducted Ninety Nine (99) number of public hearing during 2006 to 2010.

Table 1: Industry category wise breakup of the public hearing held between 2006 and 2010.

Year	Mining	Captive power plant	Steel plant	Thermal power plant	Hydro project	Industrial estate	Distillery	Dock	Airport	Highway	Aluminium smelters	Chemical	Sub total
2006	1	0	0	0	0	0	0	0	0	0	0	0	1
2007	12	1	9	6	2	1	1	1	1	0	0	0	33
2008	4	0	16	2	0	0	0	0	0	2	0	0	24
2009	4	0	22	2	0	0	1	0	1	0	1	1	32
2010	1	0	8	0	0	0	0	0	0	0	0	0	9

In the present system the project proponent prepares the draft EIA / EMP report as per the Terms of Reference (ToR) issued by the Ministry of Environment & Forests (MoEF), New Delhi or State Expert Appraisal Committee (SEAC), West Bengal and submits the report to WBPCB. The WBPCB organizes the public hearing after due consultation and confirmation about the date time and venue of public hearing from the district authorities. The date of public hearing is notified in two leading newspapers at least thirty days before the scheduled date of public hearing. The details are also uploaded in WBPCB website. The draft EIA is placed in the public domain in strategic locations as per the provisions laid down in EIA restructuring notification. In case the project site covers more than one Panchayat, the draft EIA/EMP report is usually kept in all the concerned panchayat offices for easy access of the local people. The project proponent are encouraged and pursued for disseminating information about the project proposal among the local community who resides in the vicinity of project site and who are also the stakeholders for the project. The entire public hearing is videographed. The minutes of the public bearing are finalized immediately after the public hearing and are uploaded in the website of WBPCB. After observing all due formalities mentioned in the 14th September 2006 EIA notification, the minutes of the public hearing is also forwarded to the MoEF, New Delhi or SEAC, West Bengal as the case may be.

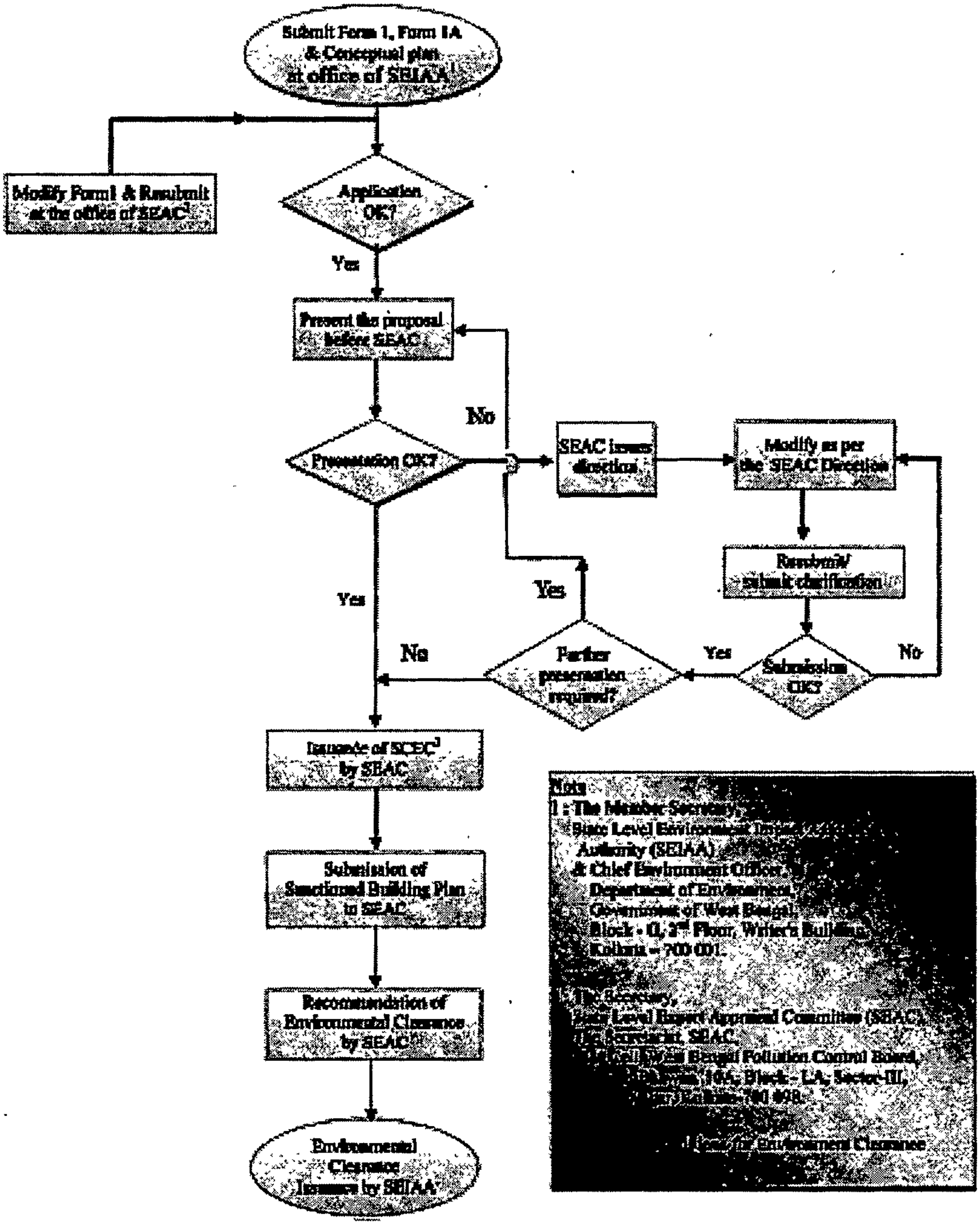
The state of West Bengal is the first state in the country to constitute State Environment Impact Assessment Authority (SEIAA) and State level Expert Appraisal Committee (SEAC) under the EIA restructuring Notification S.O.1533 (E) dated 14.09; September 2006.

In the state of West Bengal, the Department of Environment, Government of West Bengal is functioning as Secretariat of SEIAA and. WBPCB is entrusted for working as Secretariat of SEAC. This has enabled SEIAA and SEAC to avail the already existing infrastructure for environment protection in the state and also to access to the existing environmental information base as and when required. The SEIAA and SEAC are functioning in co-ordinated and complementary manner with the existing command and control regime of State Pollution Control Board and no administrative complexities has cropped up during this period.

The flow chart (Fig. 1 & Fig. 2) showing the procedure of environmental clearance of various projects.

Fig. 1 : Flow chart shows Environment Clearance Procedure for building, construction projects, townships and area development projects at state level in West Bengal

(Item No. 8 of Schedule of SO 1533 dated 14.09.2006)


Submit Form 1, Form 1A & Conceptual plan at office of SEIAA1
Modify Form1 & Resubmit at the office of SEAC2
Application OK?
Yes
Present the proposal before SEAC
No
Presentation OK?
SEAC issues direction
Modify as per the SEAC Direction
Resubmit/ submit clarification
Yes
Yes
No
Yes
No
Further presentation required?
Submission OK?
Issuance of SCEC3 by SEAC
Submission of Sanctioned Building Plan to SEAC
Recommendation of Environmental Clearance by SEAC
Environmental Clearance Issues by SEIAA1

Note

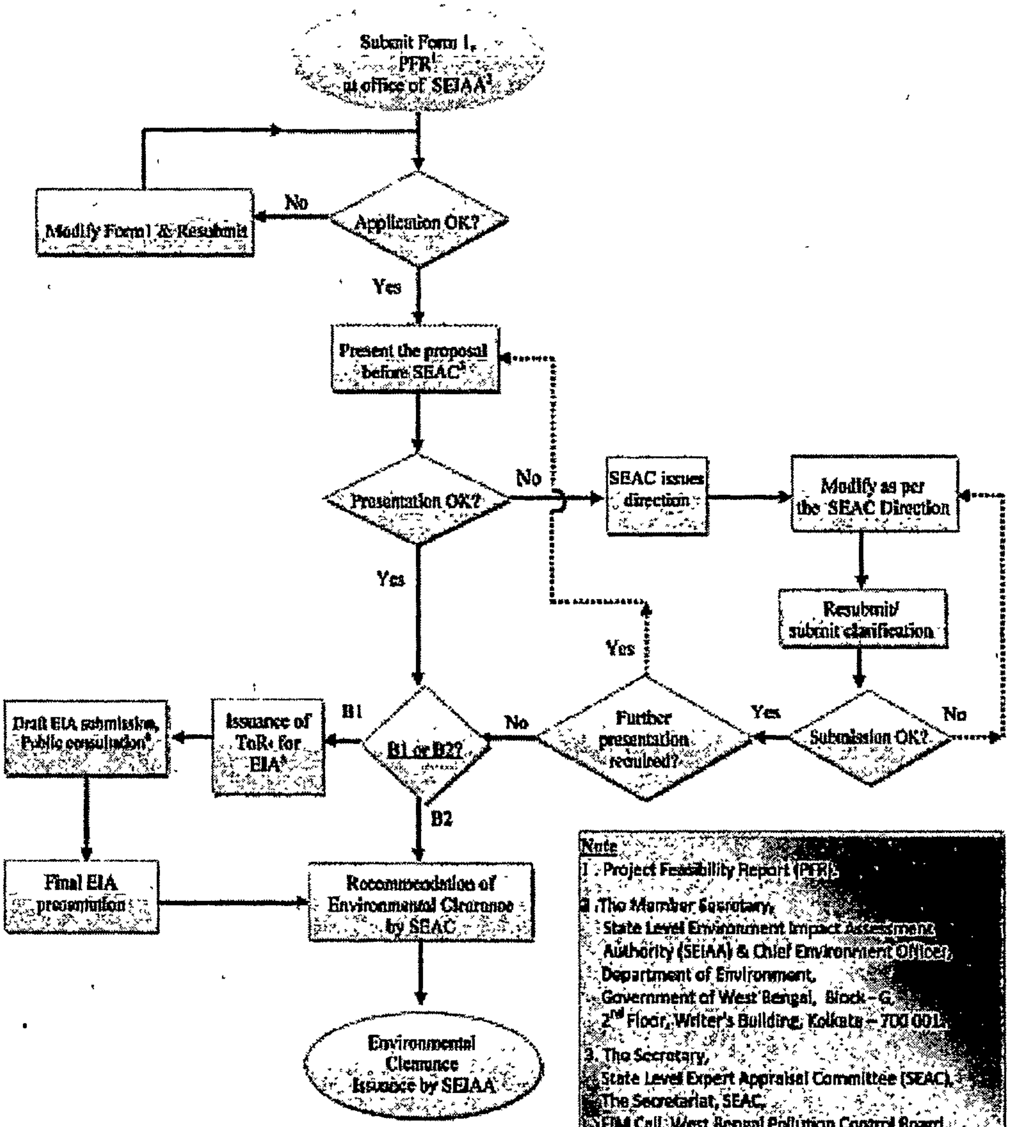
1 : The Member Secretary,
State Level Environment Impact [illegible]
Authority (SEIAA)
& Chief Environment Officer,
Department of Environment,
Government of West Bengal,
Block - G, 3rd Floor, Writer's Building,
Kolkata – 700 001.

2 : The Secretary,
State Level Expert Appraisal Committee (SEAC),
[illegible] Secretariat, SEAC,
[illegible] (Cell) West Bengal Pollution Control Board,
[illegible] 10A, Block - LA, Sector-III,
[illegible] Kolkata-700 098.

3 : [illegible] for Environment Clearance

Fig. 2 **Flow chart shows Environment Clearance Procedure for Industry sector at state level in West Bengal**

(Item No. 1 to 7 of Schedule of SO 1533 dated 14.09.2006)


Submit Form I, PFR[1] at office of SEIAA[2]
Application OK?
No
Modify Form I & Resubmit
Yes
Present the proposal before SEAC[3]
Presentation OK?
No
SEAC issues direction
Modify as per the SEAC Direction
Resubmit/ submit clarification
Submission OK?
No
Yes
Further presentation required?
Yes
No
Yes
B1 or B2?
B1
Issuance of ToRs for EIA[4]
Draft EIA submission, Public consultation[6]
Final EIA presentation
B2
Recommendation of Environmental Clearance by SEAC
Environmental Clearance Issuance by SEIAA

Note

1 . Project Feasibility Report (PFR).

2 . The Member Secretary,
State Level Environment Impact Assessment Authority (SEIAA) & Chief Environment Officer,
Department of Environment,
Government of West Bengal, Block – G,
2^{nd} Floor, Writer's Building, Kolkata – 700 001.

3. The Secretary,
State Level Expert Appraisal Committee (SEAC),
The Secretariat, SEAC,
EIM Cell, West Bengal Pollution Control Board,
Paribesh Bhawan, 10A, Block – LA, Sector-III,
Bidhannagar, Kolkata-700 098.

4. Terms of Reference (ToR)

5. Environmental Impact Assessment (EIA)

6. The public consultation including public hearing are organized by West Bengal Pollution Control Board in consultation with District Administration as per the provision of S.O.1533 (E), dt. 14.09.06

Siting Policy for Industry in West Bengal

The WBPCB ensures that compliance to environmental standards is attained through negotiated agreements and technical guidance. Under the current siting policy of the Board, the Red industries are not permitted in Kolkata Metropolitan Area (KMA) areas, and Orange industries are not permitted in Kolkata Municipal Corporation (KMC) and Howrah Municipal Corporation (HMC) areas, excepting the industrial estates of KMC and HMC. The Board also do not give permission to any new or expansion/diversification of the existing Red Category units in the areas falling under the Asansol Durgapur Development Authority (ADDA). The siting policy of the Board does not permit a few water-intensive and highly polluting industrial units having high water consumption within 10–km radius of the Calcutta Leather Complex at Bantala.

Surveillance on Industries by the WBPCB

Given the constraints of resource and manpower, the Board prioritizes its surveillance over the grossly polluting units instead of monitoring all the units under its consent administration. These units are inspected and monitored in a fixed schedule either monthly or bimonthly or thrice-a-year, or on a quarterly or half-yearly or yearly basis. The Board has identified grossly polluting units under its regular surveillance.

1. Industries identified under National River Conservation Plan (NRCP);
2. Industries discharging effluents into the rivers and lakes directly or indirectly, and effluents having BOD load of 100 kilograms per day or more before treatment;
3. Industries under 17 categories of polluting industries as notified by Ministry of Environment & Forests, New Delhi enlisted under CREP (Charter on Corporate Responsibility for Environmental Protection);
4. Major air polluting industries ;
5. Major water polluting industries ;
6. Pollution Control in Industries/ Local authorities under GAP ;

7. Major Cess paying industries since any detection of non-compliance with permissible standards prohibits industries from being eligible for claiming Rebate on Water Cess.

Regulatory Role of WBPCB

As a part of its regulatory role, all industries defaulting to meet the prescribed standard (either set up by the Ministry of Environment & Forest, Government of India or Central Pollution Control Board or WBPCB) are allowed reasonable time to comply with the standards. On repetitive non-compliance, the erroneous units are served with show-cause notices, followed by technical hearing, imposition of bank guarantee for ensuring time-bound compliance and imposition of pollution fines shows the list of hearings conducted by the Technical Cell of the Board for the financial years 2008-2009 and 2009-2010. Consistent non-compliance leads to disconnection of electricity and water supply, leading to closure of the units under extreme circumstances. Earlier such regulatory orders were issued from the Technical Cell; Since January 2010, these regulatory orders are being from the Operation and Execution Cell of the Board. After adoption of adequate pollution control measures, the closure order is suspended and the industry is allowed to operate again. Often the erring industries are required to pay Pollution Costs for the violations and Bank Guarantees to comply with the directives within a specified time frame.

Management of Hazardous Waste in West Bengal

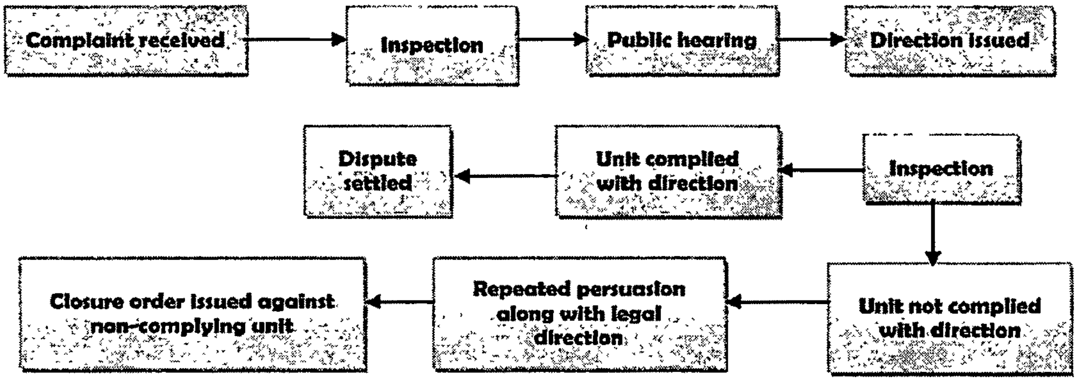
The Board has identified 762 units in West Bengal that generate about 0.246 million tonnes of hazardous wastes. Of this amount, 1, 06,097.46 tonnes or nearly 45% are disposable or incinerable while the rest are recyclable. The status of hazardous waste generation in the state as on March 2010 was as follows:

Plastic Management

The Board has limited role in the management of plastics as defined in the Plastics Manufacture, Sale and Usage Rules, 1999 as amended in 2003. The Board is responsible for enforcement of the rules with regards to manufacturing and recycling of plastics only. This includes issue of registration to all plastic carry bag and container manufacturing units, monitoring of plastic carry bag and container manufacturing units to ensure that the manufacturers comply to the rules to protect the environment.

Activities of Public Grievance Cell

Public hearing is a transparent method adopted by the West Bengal Pollution Control Board (WBPCB) for resolving the problems of people related to environmental issues. The WBPCB hearing authority is composed of a Judicial Officer and other legal and technical officers of the Board. After careful consideration of the representations from both the complainant and the aggrieved persons, necessary directions are issued. If the directions are complied within the time schedule, the case is disposed off. Otherwise, legal actions are taken against the errant unit during subsequent healings. In the ultimate case, closure order is issued until the unit adopts an adequate precautionary arrangement for control of pollution. In case the complaint is found to be beyond the legal jurisdiction of the Board, necessary suggestion letter or letter of direction is immediately sent to the concerned authorities. This process is diagrammatically represented below:


Complaint received
Inspection
Public hearing
Direction issued
Inspection
Unit complied with direction
Dispute settled
Unit not complied with direction
Repeated persuasion along with legal direction
Closure order issued against non-complying unit

Environmental Awareness Programme

In West Bengal, considering the fact above, the State Board with active cooperation of the state Government has initiated various types of environmental awareness programmes targeting the general mass of people. These positive initiatives also include Government of India sponsored National Green Corps (NGC) Programmes since 2003 throughout the country for the school children. In this regard PaschimBangaVigyan Mancha is playing important role to cooperate with the Board towards success of such programmes in West Bengal. Currently 4750 schools have been included in this programme. Apart from this, the

Board conducts various campaign programmes throughout the year utilizing the services of Non Governmental Organizations (NGOs) towards generation of environmental awareness among general people.

Conclusion

Since 1970s considerable legal and administrative efforts were made to control environmental pollution particularly from industries, vehicles, and other point sources. But non-point source pollution control is still a great challenge for our country. In many case there is gross violation of rules and regulation relating to pollution control due to lack of socio-political wisdom of the general mass as a whole.

By and large sustained environmental protection requires a participatory action between regulatory agencies and citizen together. In the present century, thus there is a need for public consultation for environmental quality improvement and environmental protection.

Reference:

Anonymous (2007) *Compendium of Environmental Statistics India.* Ministry of Statistics and Programme implementation.

Anonymous (2009) *State of Environmental report India.* Ministry of Environment and Forest, Govt. of India.

Anonymous (2010) *West Bengal Pollution Control Board, Annual Report* 2008-10.

Santra, S.C. (2006) *Environmental Science*, New Central Book Agency, Kolkata.

Planning for a Sustainable Future through an Integrated Pollution Control Framework

Nupur Sengupta[*], S. Mitra[♦] and K. M. Agrawal[♣]

Abstract

In the 21st century policy makers in the government and development specialists stand at the cross roads in choosing between environmental protection and economic development. The complex intertwining of economic factors, natural resources and environment protection can no longer be adequately handled by traditional pollution control strategies and techniques. Development planners and decision makers are therefore expected to integrate social, economic, and environmental aspects at all levels of the planning process. An expanded charter of Cleaner Production along with Sustainable Consumption will perhaps show the way – by obtaining commitments at all levels and by establishing new partnerships between government, business and communities – to take forward the agenda of sustainable development. This will not only expedite the development process but also result in an Integrated Pollution Control Framework. Accordingly, the present paper describes the evolution of notion of cleaner production and application of the concept of industrial ecology in present industrial practices. It highlights policies and methodologies to be adopted for integrated pollution control. The study also attempts to focus a critical link between cleaner production and sustainable development.

Introduction

In this century, the world appears to have gone from a state of infinite nature to one of emerging resource limits. Not only human-made capital, but the capacity of nature to provide raw materials and waste sinks (or natural capital) is also limited. Therefore, today policy makers in the government and development specialists stand at the cross roads in choosing between environmental protection and economic development. Too much emphasis on economic development tends to lead to major pollution problems, which in turn may lead to adverse impact on poor communities. Excessive importance to natural resource conservation at the expense of economic development would not generate enough national income to protect natural ecosystems. This complex intertwining of economic factors, natural resources and environment protection can no longer be adequately handled by traditional pollution control strategies and techniques. Development planners and decision makers are therefore expected to integrate social, economic, and environmental aspects at all levels of the planning process.

---

[*] Assistant Environmental Engineer, West Bengal Pollution Control Board, India.
[♦] Assistant Professor, IISWBM, Kolkata, India.
[♣] Professor, IISWBM, Kolkata, India.

In West Bengal, there are a number of industrial cluster, which are not properly managing their generated wastes, as they are not having the adequate information regarding operationalization of industrial ecology concept, though the industrial wastes have enormous recycling and reuse potential either in the same unit or in the other units of an industrial cluster, in most of the cases.

The present paper describes the evolution of notion of cleaner production and application of the concept of industrial ecology in present industrial practices. It highlights policies and methodologies to be adopted for integrated pollution control. The study also attempts to focus a critical link between cleaner production and sustainable development.

Key Factors for Integrated Economic and Environmental Planning

Modern environmental consciousness in conventional planning activities dates back from a series of environmental disasters in the 1960s, which include mercury poisoning in Minamata, Japan, the pesticide exposure of Rachel Carson's "*Silent·Spring*" and so on. These disasters invited public concern through strong media attention. Moreover, it is alarming to mention that the Environmental Pollution Index (EPI), 2012 released by Environmental policy researchers at Yale University and Columbia University in the US, has ranked India 125 among 132 countries. Moreover, air quality in India has been ranked 132, the worst in the world, whereas, water quality has been ranked 126 and agricultural 121. The successive environmental disasters demonstrated that contemporary environmental management techniques were incapable of protecting the environment and that the planning approach should recognize the linkages between human-made and natural capital and integrate social, cultural, political, economic and environmental issues.

After the Stockholm Conference on the Human Environment in 1972, various environmental legislations came up in different countries which led to formation of new organizations, such as the US Environment Protection Agency and Council on Environmental Quality, and also initiate development of new planning tools and techniques, most notably Environmental Impact Assessment. Subsequently, the United Nations Conference on Environment and Development (UNCED) at Rio de Janeiro in 1992, *Agenda 21*, endorsed by more than 150 nations, called for national sustainable development strategies to be developed which would integrate social and economic development with the environment.

Present Scenario with respect to Pollution Control Strategies & Policies in West Bengal

In India, the West Bengal State Pollution Control Board, a statutory regulatory body, was constituted in 1974 as per the provisions of the Water (Prevention and Control of Pollution) Act and entrusted to implement environmental laws and rules within the jurisdiction of the state of West Bengal. The main activities of the Board are:

- Comprehensive planning for prevention, control or abatement of water and air pollution in the state and its execution through control of pollution from various industrial sources,
- Waste management particularly municipal solid waste, hazardous and biomedical wastes,
- Monitoring of various environmental parameters,
- Addressing public grievance pertaining to environmental pollution,
- Controlling pollution from automobiles,
- Imparting training programs to different personnel closely involved in pollution control activities,
- Creating awareness amongst general public and especially school children through participation in various activities and so on.

Besides, the Board also undertakes special projects on capacity building and other aspects for curbing environmental pollution. The Board under section 25 and 26 of the Water (Prevention and Control of Pollution) Act 1974 and under section 21 of Air (Prevention and Control of Pollution) Act 1981 issues permission for establishing and operating of any industrial activity in the form of permits which are valid for a certain period of time and subject to be renewed based on satisfactory performance of the industry based on environmental considerations. Board also issues 'Authorisation' to units which are producing Hazardous Wastes, Biomedical Wastes or Municipal Solid wastes.

For combating industrial pollution, an industrial siting policy of the Board is in place. Under this policy, industries with high pollution potential are not permitted in certain areas depending on the carrying capacity of the environment. Identified grossly polluting industries are closely monitored for regulatory compliance on an immediate basis.

In case of noncompliance, industries are called for hearing and necessary regulatory orders are issued in the form of Closure of an Industry, Direction, in some cases penalty in the form of Pollution Cost and Bank Guarantee are imposed to ensure compliance with the regulatory framework.

Certain steps have been taken for controlling pollution like imposition of stricter emission standards for boilers, ceramic kilns, foundries etc. Restrictions have been imposed on siting of industries in areas having high population density or areas which are already severely polluted and for example the Kolkata Metropolitan area and Howrah Municipal Corporation.

The task of identification and ranking of important industrial clusters of the country based on various dimensions of pollution like air, water, soil has been undertaken by the Ministry of Environment and Forests, Government of India and a comprehensive Environment Pollution Index (EPI) has been developed. This EPI will help identifying and assessing critically polluted industrial areas in the country and formulation of adequate action plan for environmental sustainability on a priority basis for such areas.

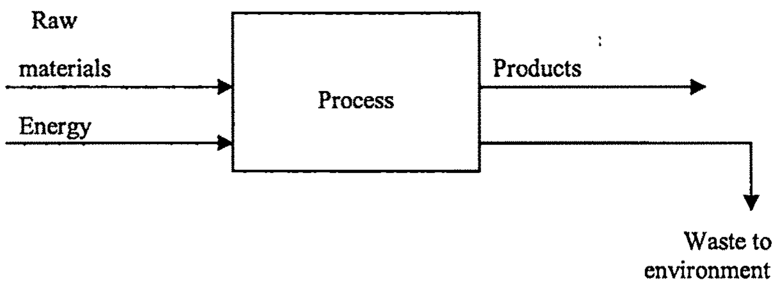
These action plans should be appropriately integrated with the development strategies and planning approaches in overall decision making considering the importance of link between environment imperative and economic development. Such critically polluted industrial areas identified in the State include parts of Haldia, Howrah and Asansol which require specific plan of action to make the process of industrial development and economic growth more sustainable.

Cleaner Production & Sustainable Development

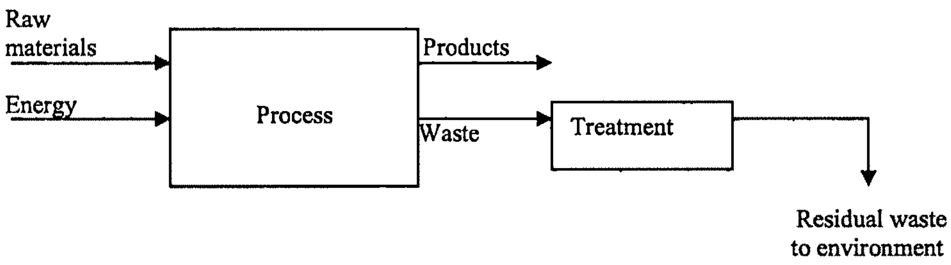
In the past, industry showed little concern for the types or amounts of waste generated, and the public had little knowledge of the impacts of these wastes on the environment. These wastes were usually just discharged into the air or nearby river or they were dumped or buried on land (Fig. 1A). Disposed materials that were thought to be gone forever through dilution in air or water or by burial in the ground came back to haunt us. As these impacts became known, industries began to treat their wastes to remove the most egregious ones (Fig. 1B). Eventually, some industries began recycling and reusing some of their waste materials (Fig. 1C). Other industries, recognizing that product marketing and pollution prevention are intimately related, began marketing the environmental "greenness" of their products as a way to attract new customers. This was the beginning of the pollution prevention era. Further to meet the goal of sustainable development industry need "zero pollution," in which most process wastes production is eliminated through process changes and as much remaining waste as possible is recycled, reused or reclaimed (Fig. 1D).

Fig. 1 Recent and Proposed Industrial Waste Management Practices

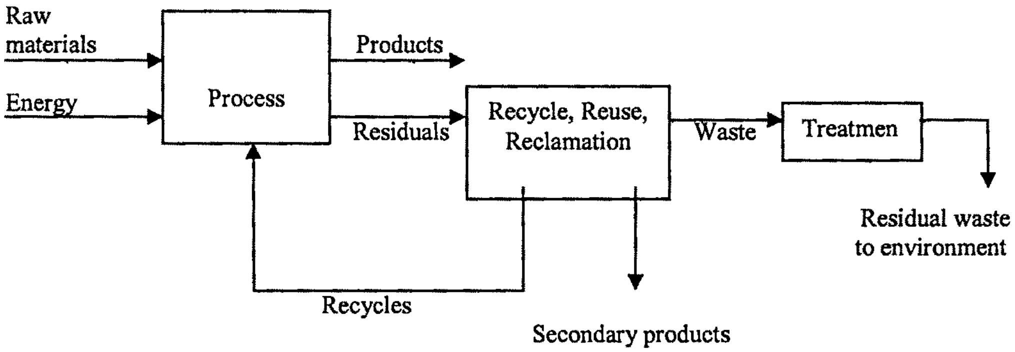
(A) Past Industrial Practices



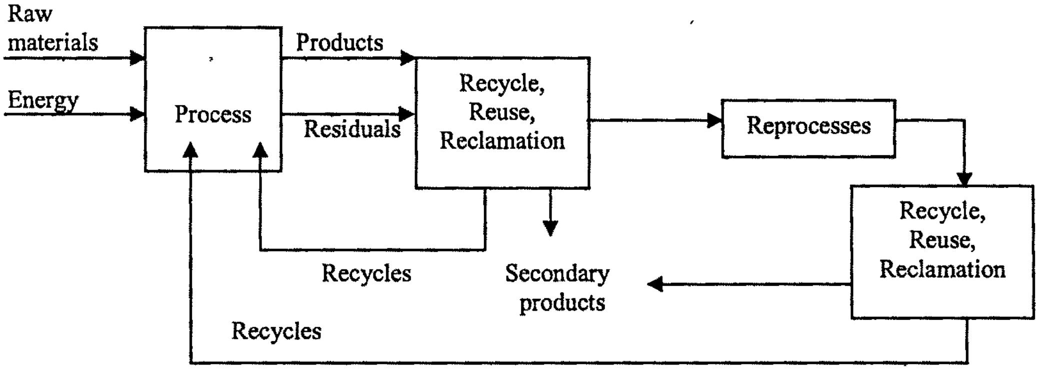
(B) Recent Industrial Practices



(C) Current Pollution Prevention Practices



(D) Ideal Future Industrial Practices



It is estimated that our materials-dominated society consumes about 10 metric tons of raw materials per person per year in the production of consumer goods. Within six months of extraction or production of these materials, 94% of them become residual material that is disposed of as waste. It is estimated that 70% of this waste material could be eliminated through better design decisions and reuse of materials. More efficient practices for using materials in manufacturing are needed to lessen the demands for raw materials and to reduce the amounts and toxicity of waste materials and here lies the need of implementation of Cleaner production.

Cleaner Production (CP) is the international term for reducing environmental impacts from processes, products and services by using better management strategies, methods and tools. It is "the continuous application of an integrated preventive environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment" (United Nations Environment Programme). CP is called Pollution Prevention (P2) in North America and Production Mas Limpia (PL) in Latin America (http://www.cleanerproduction.com). Thus cleaner production encompasses a number of related terms, viz., Source Reduction, Pollution Prevention, Zero-waste technology, Eco-technology, Low- and non-waste technologies, Waste/pollution minimization, Green productivity, Eco-profit technology, Green Business, Sustainable Business, Eco-efficiency (http://cptech.dost.gov). Accordingly, efficient utilization of natural resources, environmentally sustainable production process, application of 3Rs - 'Recovery', 'Recycle' and 'Reuse' of industrial wastes would lead to create a pollution free environment, which in turn result in greater competitiveness and improved relationship between the industry and the community. As sustainable development implies meeting the needs of the present generation without compromising the need of future generations, therefore, the key idea, which lies behind the concept of sustainable development, is that there is a trade-off between continuous economic growth and the sustainability of the environment. For the purpose of meeting this target, 21st century is now concerned for adopting 7-R Golden Rules for implementation of 3-R:

The first R is 'Regulation' where Government and Decision Makers should develop rules and regulations to encourage and enforce 'Industrial Ecology (IE)' concept. 'Reduce', 'Reuse' and 'Recycle' are the common criteria for waste management in general which is always referred to as the waste management criteria. Fifth R is 'Recovery' of raw material from waste (waste-to-energy recovery). 'Rethinking' and 'Renovation' where people should rethink about their waste before taking action for treatment and disposal and develop Renovative or Engineering techniques to solve the problem.

Each of these terminologies implies the use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source. It also means the practices that reduce the use of hazardous and non-hazardous materials, energy, water, or other resources as well as those that protect natural resources through conservation or more efficient use.

The strategic foundation of cleaner production and Pollution Prevention is Life Cycle Assessment (LCA). It is an analysis covering every stage and every significant environmental impact of a product from the extraction and use of raw materials through to the eventual disposal of the components of the product and their decomposition back to the elements. The information from LCA is used to select specific technology, design products and services to reduce impacts and increase sustainability of products and services and the entire life cycle chain of production and companies (Agrawal, 2009).

Policies and Methodologies to be Adopted for Integrated Pollution Control

As per the Guidelines proposed by IUCN, ten steps have been identified for adopting a planning approach to implement *Agenda 21,* and for formulating national strategies for sustainable development:

(i) define goals, targets and standards;

(ii) analyze ecological, economic and social issues, clarifying linkages, identifying policy gaps;

(iii) prepare sectoral and cross – sectoral policies and plans;

(iv) identify and apply practices to sustain the resource base of the economy;

(v) determine priorities for action, evaluating costs and benefits and the trade-offs;

(vi) allocate limited resources;

(vii) build capacities to handle complex and interrelated issues;

(viii) rationalize legislation;

(ix) improve decision making through better information and analytical techniques, and by enabling those most affected by decisions to contribute to them; and

(x) develop understanding and build consensus so that decisions have strong support.

By adopting the above as a participatory and cyclical process of planning and action, economic, ecological and social objectives can be achieved in a balanced and integrated manner.

Thus, sustainable development planning need to be supported by (i) environmental information systems (ii) state of the environment reports (region wise) (iii) natural resources accounting and (iv) environmental indices. Of these, data collection leading to reliable state of environment reporting is most important. Secondly, natural resource accounting or environmental accounting involves modifying the system of national accounting system to reflect environmental and natural resource issues like inclusion of defensive expenditures to protect or restore the environment, and deductions for the depletion and degradation of natural resources. Thirdly, calculation of EPI which is an index of Environmental Quality, would measure the defensive and repair costs to achieve international minimum environmental quality standards, and can be a useful complement to the Human Development Index and GNP.

Conclusion

In the last decade, CP has attempted a paradigm shift in environmental management at the level of governments, business and financing institutions, as well as local governments and communities. However, there has been a number of barriers in the promotion and adoption of CP. Several strategies have also been deployed to overcome some of the barriers.

To develop and implement a CP action plan, it will be necessary to establish a situation specific operational framework by involving stakeholders, identifying needed prerequisites and overcoming barriers. An expanded charter of CP along with Sustainable Consumption will perhaps show the way – by obtaining commitments at all levels and by establishing new partnerships between government, business and communities – to take forward the agenda of sustainable development.

Thus, development strategies and planning approaches should be such that economic, social and environmental factors are thoroughly integrated at all levels of society, to avoid the unintended consequences of unilateral development in any one factor and to contribute to sustainable development. For developing an integrated pollution control policy, a single permit may be issued integrating the wastewater discharge causing water pollution, air emission, all types of wastes management and ground water abstraction, soil pollution so that all the developmental activities that lead to environmental degradation can be dealt with a single licensing process. This will not only expedite the development process but also result in an integrated Pollution Control Framework.

References:

ADB, (1988) *Guidelines for Integrated Regional Economic-cum-Environmental Development Planning*, Volumes I and II, Asian Development Bank, Manila.

Agrawal, K. M. (1996) *Clean/Green Technologies and Environmental Management Challenges in Indian Industries*, Proc. of Seminar on *'Green Technology and Environmental Concern'*, Environment Management Department, IISWBM, Kolkata, pp. 19 – 21.

Agrawal, K. M. (2009) *Cleaner Production: A Vision for Sustainable Development*, Proc. of Celebration of 42nd Engineers' Day on 'Engineering Solutions to Combat Climate Change', The Institution of Engineers (India), Kolkata, September 15.

Arif, Nazeeb (2000) *Launch of the West Bengal Cleaner Production Centre -Environment Watch*, Environment Management Centre of the Indian Chamber of Commerce, Nov–Dec.

Bishop, Paul L. (2000) *Pollution Prevention: Fundamentals and Practice*, McGraw-Hill International Editions, USA.

Freeman, Harry M. (1995) *Industrial Pollution Prevention Handbook*, McGraw-Hill, Inc., USA.

King, Peter N. (1997) *Integrated Economic, Social and Environmental Planning in the Pacific Region*, ADB.

National Environment Policy (2006) Ministry of Environment and Forests, Government of India.

Uberoi, N. K. (2002) *Environmental Management,* Excel Books, New Delhi.

Welford, Richard (1999) *'Environmental Issues and Corporate Environmental Management,' Corporate Environmental Management*, Universities Press (India) Limited, Chapter 1, pp. 1 – 12.

West Bengal Pollution Control Board (2008-2010) *Annual Report,* Department of Environment, Government of West Bengal.

http://www.cleanerproduction.com, accessed on February, 2012

http://cptech.dost.gov, accessed on February, 2012

http://www.moef.nic.in/, accessed on February, 2012

http://www.defra.gov.uk/environment/quality/industrial, accessed on February, 2012

Section B

New and Emerging Environmental Management Perspectives

Transforming Arsenic Crisis into an Opportunity for Economic Growth in South and South East Asia

Sudipta Sarkar[*], Hul Seingheng[♦], Davin Uy[♦], Anirban Gupta[♠] and Arup SenGupta[♣]

Abstract

This article brings into focus the arsenic contamination of ground water in South & South-East Asia in general and West Bengal in particular. The author mentioned the areas (mainly the villages) affected by such contamination and thereby the harmful effects on humans due to consumption of such contaminated ground water. In the latter half the author focused on a unique community based business model following an innovative technological intervention, taken up by the villagers so as to ensure availability of clean and safe drinking water which is free from arsenic contamination.

Introduction

Although unknown nearly twenty five years ago, natural arsenic contamination of groundwater has emerged as a major global crisis affecting over fifty countries around the world (1). The adverse health effects are, however, most prevalent in South & South-East Asia where over 200 million people, according to World Health Organization (WHO), are threatened with arsenic-inflicted health impairment (i.e., arsenicosis) caused by drinking of contaminated groundwater. The use of groundwater in these regions is favored because of its easy availability due to natural recharging of the aquifers, low salinity and absence of microbial contamination.

---

[*] Assistant Professor, Department of Biotechnology and Environmental Sciences, Thapar University, Punjab, India.

[♦] Professor, Department of Food and Chemical Engineering, Institute of Technology of Cambodia, Phnom Penh, Cambodia.

[♦] Professor, Department of Food and Chemical Engineering, Institute of Technology of Cambodia, Phnom Penh, Cambodia.

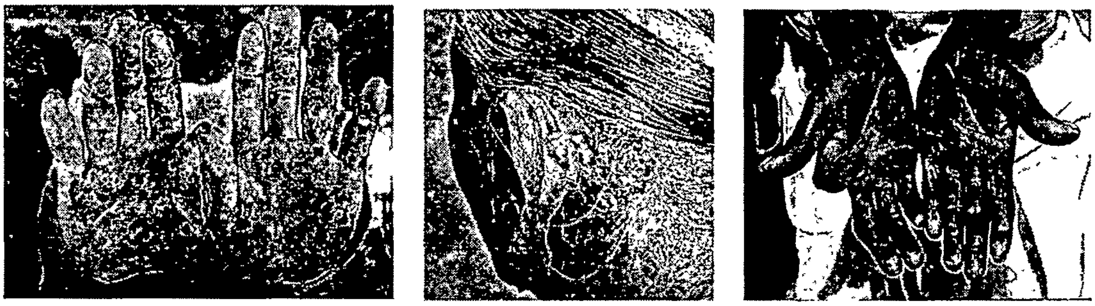
[♠] Professor, Civil Engineering Department, Bengal Engineering and Science University, India.

[♣] Professor, Corresponding Author, Professor, Department of Civil and Environmental Engineering, Lehigh University, Pennsylvania, USA.

Arsenic is by far the most toxic contaminant present in groundwater and it enters into the aqueous phase through biogeochemical leaching of soil. In the arsenic-affected region bordering the Indian state of West Bengal and Bangladesh, it was conclusively demonstrated that arsenic removal systems in rural areas, with appropriate choice of technology and community involvement, can be sustained on a long-term basis through active participation of villagers (2-5). Nearly two hundred such systems have been operating there for several years providing arsenic-safe water to nearly 200,000 villagers.

Arsenic crisis in countries in Southeast Asia, namely, Cambodia, Laos and Vietnam, emerged almost a decade later. Although rain water harvesting offers some relief to relatively affluent villagers during the monsoon period, arsenic-contaminated groundwater remains as the only viable source for safe drinking water in hundreds of villages in Mekong delta. The level of arsenic contamination in Kandal province in Cambodia and the neighboring region is by far the highest, often exceeding 500 μg/l while the permissible level according to World Health Organization (WHO) is only 10 μg/l. Arsenic does not impart color, taste or odour in water. Also, the health related impairment caused by arsenic poisoning from drinking water is slow and takes several years before becoming fatal from a life-threatening viewpoint. It is initially dominated by changes in the skin through formation of hard dark scales accompanied by lesions (hyperkeratosis) followed by malignancy in many cases (Fig. 1).

Fig. 1 Severe Health effects of ingestion of water with contaminated with high concentration of arsenic.

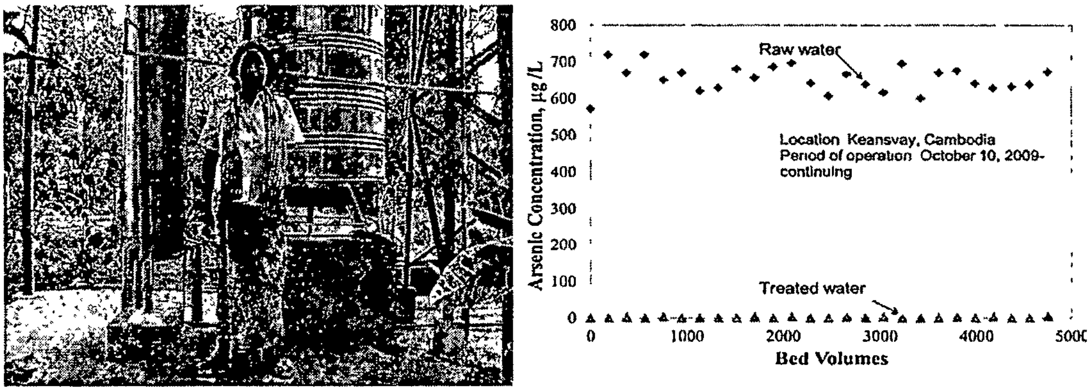


Cambodia Bangladesh India

Community Based Intervention and Concomitant Economic Growth

Following the success in the Indian subcontinent, the first SARSAC (Sustainable Arsenic Removal System in Affected Communities) unit was installed in Preak Eng commune in Kandal province, Cambodia in October 2009 (Fig. 2A); it resulted from an ongoing collaborative project between Lehigh University in Pennsylvania, USA and the Institute of Technology in Cambodia (ITC). The lady in the picture, who has apparently lost her one hand due to arsenic-related malignancy, is responsible for day to day operation of the treatment unit along with her family. Regenerable arsenic-selective hybrid anion exchanger (HAIX), now commercially available, forms the heart of the process (6-7). A few more SARSAC units quickly followed in Kandal province in Cambodia. The plant is simple to operate and a reusable hybrid arsenic-selective adsorbent forms the heart of the process. Fig. 2B shows how the SARSAC unit is consistently removing arsenic from the severely contaminated groundwater.

Fig. 2(A) Photograph of an arsenic removal unit in Kandal Province in Cambodia and (B) The arsenic removal performance of the unit.

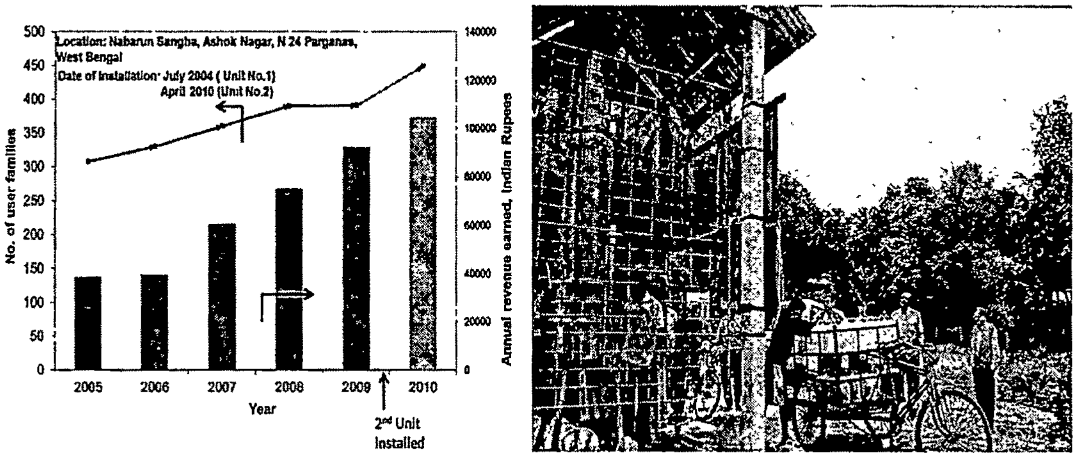


(A) (B)

An earlier study in India revealed that community-based systems, once delivered with villagers' participation and sense of ownership, are easy to sustain. For economic sustainability, a business model was created where every participating household is required to pay a small amount of tariff (40 US cents per month per family for 20 liters of arsenic-safe water every day) and every human labor is fully or partially compensated using the tariff paid by villagers. A villagers' committee, formed by participating households, is responsible for collection of tariff, its disbursement, day-to-day operation and overall ownership of the community-based system. We closely monitored the economic growth of the SARSAC unit run by a local club (Nabarun Sangha) in North 24 Parganas in West Bengal ever since its inception in late 2004. This is also the first community-based unit to use the polymer-based reusable arsenic-selective adsorbent, also referred to as hybrid anion exchanger or HAIX.

Fig. 3A shows how the community participation and the revenue collected from participating families through tariff gradually increased with time for five years in Nabarun Sangha. The single SARSAC unit was found inadequate to meet the demand of arsenic-safe drinking water in the village and the adjoining area. In 2009, through a grant from the United States Environmental Protection Agency (USEPA) P3 Award, a second unit was installed. The number of participating families immediately increased and is still on the rise. As the demand for arsenic-safe water gradually increased from distant places, a group of enterprising young people in many villages started water vending using local transport (rickshaw van) with a value-added price (Fig. 3B). In essence, through intervention of appropriate technology and a community-based business model, the arsenic crisis was transformed into a business enterprise. Now there are over 100 such community based arsenic removal systems in the bordering areas of West Bengal, India and Bangladesh that are run, operated and financially sustained by villagers.

Fig. 3(A) Revenue earned from collection of water tariff at the arsenic removal unit at Ashoknagar, West Bengal, India and (B) Water vending to serve arsenic-safe water to communities at distant locations.



(A) (B)

Acknowledgment

Financial assistance was received from the United States Environmental Protection Agency (USEPA) P3 grant, National Collegiate Inventors and Innovators Alliance (NCIIA), Lehigh University, Water for People and private donors.

References:

Ravenscroft, P; J.M. McArthur; B.A. Hoque (2001) *Geochemical and Paleo-Hydrological Controls on Pollution of Groundwater by Arsenic.* In *Arsenic Exposure and Health Effects,* (eds. Chappell W, Abernathy CO, Calderon R.), *Oxford: Elsevier*, pp. 83-87.

Sarkar, S; A. Gupta; R. K. Biswas; A. K Deb; J. E. Greenleaf; A. K SenGupta (2005) *Well-head arsenic removal units in remote villages of Indian subcontinent: field results and performance evaluation,* Water Res.39: 2196-2206.

Sarkar, S.; L. M Blaney; A. Gupta; D. Ghosh; A.K. SenGupta (2008). *Arsenic removal from groundwater and its safe containment in a rural environment: validation of a sustainable approach,* Environ. Sci. Technol., 42:4268-4273.

Sarkar, S; J. E Greenleaf; A. Gupta; D. Ghosh; L. M Blaney; P. Bandyopadhyay; R. Biswas; A. K. Dutta; A. K. SenGupta (2010) *Evolution of community-based arsenic removal systems in remote villages: assessment of decade-long operation,* Water Res. 44:5813-5822.

Sarkar, S; J. E. Greenleaf; A. Gupta; D. Uy; A. K. SenGupta (2012) *Sustainable Engineered Processes to Mitigate Global Arsenic Crisis in Drinking Water: Challenges and Progress, Annual Rev Chem Biomol Engineering,* 3, 497-517.

Sarkar, S.; E. Guibal; F. Quignard; A. K. SenGupta (2012) *Polymer-supported metals and metal oxide nanoparticles: synthesis, characterization, and applications,* Journal of Nanoparticle Research, 14, 715.

SenGupta, A. K.; L. H. Cumbal (2007) *Hybrid anion exchanger for selective removal of contaminating ligands from fluids and method of manufacture thereof. U.S. Patent No. 7,291,578.*

Industrial Ecology – A Paradigm Shift to Closed Loop System For Waste Management

K. M. Agrawal[*], S. C. Santra[♦], S. Mitra[♣] and I. Sadhukhan[♠]

Abstract

In the new millennium, the human civilization is posed with serious challenges of rapid population growth, fast depletion of natural resources, severe environmental pollution and damage to fragile ecosystems through which life on Earth survives. Increased level of industrial activity to meet the demands of human beings has caused irreversible damage to pristine ecosystem that earth once had. Thus, it becomes very much important of a gradual shifting in orientation of business or industrial management towards sustainable environment management. Accordingly, in this study initially various industry specific models have been evolved for operationalizing the industrial ecology concept. Finally an integrated model for various types of industries located in particular industrial ecology zones has been evolved. The implementation of proposed integrated industrial ecology model for operationalizing the IE concept would not only further reduce the production cost significantly but also provide additional avenues for recycling and reuse of the various types of wastes in the same unit or in the other units leading to significant reduction in health and environmental risks.

Introduction

Industrial pollution control and sustainable environment management have emerged as a challenging task for industry and business in recent past, as application of end-of-pipe solution to meet stringent regulatory requirement are exorbitantly expensive. Therefore, it has been apprehended that the time has come to save our limited resources and minimize the overburden of the industrial wastes by implementation of Industrial Ecology (IE) concept through recovery, recycle and reuse of the generated industrial wastes, which will help to meet the needs of present generation without sacrificing the needs of future generations through sustainable development.

---

[*] Professor (Environment Management) & Head, MPSM, IISWBM, Kolkata, India.

[♦] Professor, Environmental Science, University of Kalyani, India.

[♣] Assistant Professor & Coordinator, MPSM (Environment Management), IISWBM, Kolkata, India.

[♠] Assistant Manager, QSHE & OEC Division, Jai Balaji Industry Private Limited, Durgapur, India.

Of late, closed-loop thinking, i.e. reuse and recycle, resource efficiency and pollution prevention has begun to emerge; this saves money for industry & society and reduces the need for costly regulations (Allenby and Richards, 1994). This closed-loop thinking is progressing to tracing resource flow within the industry and between the industries to reduce waste & pollution and exploring waste exchange opportunities. So, it could be said that the development of industrial ecology is an attempt to provide a new conceptual framework for understanding systems on the environment. This system based framework enables management of human activity to levels that natural systems can sustain, conserving and restoring natural ecosystem health maintaining biodiversity and ecological viability of systems for industry, trade and commerce. This kind of initiatives also promotes the producers of industrial goods and providers of services to produce more with less raw material, less energy and water, less waste and thus less environmental impact – all contributing to sustainability.

In this context, it is interesting to understand the complete genesis of the major polluting industries and the possibilities and potentialities of these industries in the viewpoint of waste minimization by recycle and reuse of the waste.

In case of industrial sector of developing country like India, progress in dealing with industrial pollution related issues has not been made very systematically on several fronts during the past several decades. Although a good number of studies have been conducted on issues regarding industrial pollution control, very few of them focused on the implementation of the industrial ecology concept in the industrial hubs or industrial zones. The ever-increasing industrial pollution related problems could not be solved by enactment of environmental rules & regulations and implementation of environmental standards by the regulatory agencies. So, the time has come to take some positive initiatives by the governmental and non-governmental bodies, policy makers, industrial authorities and other stakeholders to minimize the industrial overburden by operationalizing the industrial ecology concept.

Like the developed countries, developing countries are also facing the problems of management and minimization of the industrial wastes because, today, it is understandable that environmental management through implementation of industrial ecology concept is not only an example of industrial waste management through cleaner production and optimum reuse and recycle of the industrial waste, but also is an issue of sustainable industrial operation and business practice.

Most of the environmental problems result from polluting production processes, certain kinds of excess consumption of raw materials due to inefficiency of the furnaces or processes, ineffective management of industrial pollutants and disposal of wastes without any recycle or reuse, leading to environmental as well as industrial degradation. Therefore, a good environmental friendly industrial profile is often more of an asset for an industry than a liability in the international market place, notwithstanding somewhat higher production cost. Thus, industries can be able to take decision on how to reduce main and auxiliary raw materials consumption, where to reduce energy intake, how to recycle and reuse industrial wastes, etc. Again, industrial products and by-products would unambiguously raise welfare to the society through implementation of suitable industrial waste management system in sustainable basis. Accordingly, the present paper explores the understanding of different types of wastes generated in the industries and their recycle and reuse potentiality along with minimization possibilities of resource depletion with some established product optimization models and cost effective analysis. The present study also led to development of models for operationalizing Industrial Ecology along with cost-benefit analysis for selected industrial zone of West Bengal.

Objectives of the study

The prime objectives of the present study were:

- Quantification of raw material consumption and wastes generated in industrial hub(s);
- Assessment of the potential of various types of wastes for recycling or reuse;
- Quantification of benefits of recycling or reusing of wastes;
- Analyzing cost-benefit of operationalizing IE concept in industrial hub(s).

Research methods

Description of Data & Methodology

In addition to collecting the secondary information from various sources, a specific questionnaire was developed to collect the data from the various industries located in the selected industrial hubs. After designing the preliminary questionnaire, some review was made based on discussion with the officials (environmental engineers) of West Bengal Pollution Control Board (WBPCB) and West Bengal Industrial Development Corporation (WBIDC) as well as officials of the various regulatory agencies including the various Chambers of Commerce i.e. Indian Chamber of Commerce and Bengal National Chamber of Commerce and company executives working in the field of environment management.

WBIDC, Government of West Bengal has divided the entire State into 6 zones on the basis of geographical location, existing concentration of industries, availability of raw materials and basic infrastructural facilities, etc. for industrial developmental purpose. Accordingly, to select the specific target industrial units, the method of stratified random sampling (Gun, Gupta and Dasgupta, 2002) was used and subsequently, the sample size for the present study was determined.

The information was collected on the basis of personal interview and group discussions with executives (e.g. production manager, marketing manager, Personnel Manager/HRD Manager, general factory manager, factory engineers, plant inspector, environmental officer, safety officer or safety, health & environment (SHE) officer and workers of the target industrial units).

Description of Sample

WBPCB has divided the industries of the State mainly into three sectors i.e. large scale industries, medium scale industries and small scale industries, according to their size (Annual Report, West Bengal Pollution Control Board, 2007-2008). The typical example of small and medium sector industries operating in large numbers in the State having serious environmental problems are cast iron foundries, hot rolling mills, secondary lead smelting units, galvanizing units, rubber industries, dyeing & bleaching industries, anodizing industries, chrome chemical manufacturing industries, etc., which are operating mostly in the congested areas of the State over the years. New industrial development as large & medium scale sectors are taking place in the area of thermal power plants, sponge iron industries, pig iron industries, ferro-alloys industries, coke making units by beehive process, cement grinding units, etc. It was found from the analysis that out of total 645 large and medium scale industries of West Bengal falling under red, orange and green categories, 591 (78.28%) are large and 164 (21.72%) are medium scale industries.

The Central Pollution Control Board and the Ministry of Environment & Forests have evolved Charter on Corporate Responsibility for Environmental Protection (CREP) that enlists action points for 17 categories of highly polluting industries (Annual Report, West Bengal Pollution Control Board, 2007-2008). As per the CREP, the State Pollution Control Boards are required to verify compliance status of 17 category of highly polluting industries with the National Standards notified under the Environment (Protection) Act, 1986. The 17 Categories of the major polluting industries identified by CPCB and MoEF are depicted in Table 1.

Table 1: Categorization of Major Highly Polluting Industries by CPCB & MoEF

Sl. No.	Category of Industries	Sl. No.	Category of Industries
1.	Aluminium Smelter	10.	Pesticides
2.	Caustic Soda	11.	Petrochemicals
3.	Cement	12.	Drugs & Pharmaceuticals
4.	Copper Smelter	13.	Pulp & Paper
5.	Distilleries	14.	Oil Refineries
6.	Dyes & Dye Intermediates	15.	Sugar
7.	Fertilizer	16.	Thermal Power Plants
8.	Iron & Steel	17.	Zinc Smelters
9.	Tanneries		

Again, according to the types of waste generated in the industries, they were classified as industries causing air pollution (thermal power plants, iron & steel industries, etc.), industries causing water pollution (sugar factories, textile, pulp & paper industries, chemicals, distilleries, refineries, etc.) and industries producing solid wastes (iron & steel industries, mining sector, etc.).

Accordingly, in the present study, after identification of the various types and categories of industries present in each identified industrial ecology zone, the inventory of wastes were made, which was assessed in terms of their recycling and reuse potentiality in the same unit or in the other units of the same industrial ecology zone. In the present study, following industrial sectors were selected:

- Iron & Steel Industry - Sponge Iron Industries; Pig Iron Industries; Cast Iron Foundries, etc.
- Thermal Power Plant
- Cement Industry - Portland Pozzolana Cement Industries; Portland Slag Cement Industries

Empirical Results

Quantification of Consumption of Raw Materials & Generation of Waste

Sponge Iron Industries: In West Bengal, there are 56 sponge iron industries. The main raw materials consumed by the sponge iron industries are iron ore, coal, dolomite, water and electricity. The overall average consumption rate of iron ore, coal and dolomite are 1.9914 MT/MT_{SI}, 1.6590 MT/MT_{SI} and 0.0529 MT/MT_{SI}. Most of the sponge iron industries recycle the industrial waste water and average water consumption rate (as make up water) due to evaporation loss for industrial purpose is 2.1594 M^3/MT_{SI} and the specific electricity consumption for 1 MT sponge iron production is 125 KWh.

The main solid wastes generated from the sponge iron industries are coal char and dust. The overall average rate of generation of coal char, coal fines and dust in the sponge iron industries are 0.4002 MT/MT_{SI}, 0.2003 MT/MT_{SI} and 0.0702 MT/MT_{SI}.

Pig Iron Industries: In West Bengal, there are 38 numbers of pig iron industries. The main raw materials consumed by the pig iron industries are iron ore, hard coke, dolomite, manganese ore, quartzite, water and electricity. The overall average consumption rate of iron ore, hard coke, limestone, manganese ore and quartzite are 1.8668 MT/MT_{PI}, 0.7400 MT/MT_{PI}, 0.1297 MT/MT_{PI}, 0.0341 MT/MT_{PI} and 0.0328 MT/MT_{PI} respectively. Most of the pig iron industries recycled the industrial waste water and average water consumption rate (as make up water) due to evaporation loss for industrial purpose is 2.1021 M^3/MT_{PI} and the specific electricity consumption for 1 MT pig iron production is 165 KWh.

The recyclable solid wastes generated from the pig iron industries are blast furnace slag and dust. The overall average rate of blast furnace slag (BF) and dust generation in the pig iron industries are 0.3900 MT/MT_{PI} and 0.0591 MT/MT_{PI} respectively.

Cast Iron Foundry: In West Bengal, there are more than 200 registered cast iron foundry, out of which, presently 107 cast iron foundries (CI) are operational. The main raw materials consumed by the cast iron foundries are pig iron, cast iron scrap, limestone, hard coke, foundry return, silica sand, water and electricity. The overall average consumption rate of pig iron, cast iron scrap, limestone, hard coke and foundry return are 0.6651 MT/MT_{CI}, 0.4288 MT/MT_{CI}, 0.0874 MT/MT_{CI}, 0.2588 MT/MT_{CI} and 0.2500 MT/MT_{CI} respectively. All the sampled cast iron foundries reuse silica sand (used for moulding purpose), but 0.0932 MT/MT_{CI} new silica sand is required for replacement of non-reusable silica sand. Most of the cast iron foundries recycle the industrial waste water and average water consumption rate (as make up water) due to evaporation loss is 0.0529 KL/MT_{CI} and the specific electricity consumption for 1 MT cast iron production is 110 KWh.

The wastes generated from the cast iron foundries are CI slag, waste sand and dust. The overall average rate of CI slag, waste sand and dust generation in the cast iron foundries are 0.1029 MT/MT_{CI}, 0.0692 MT/MT_{CI} and 0.0067 MT/MT_{CI} respectively.

Thermal Power Plants: In West Bengal, there are 16 coal based thermal power plants (TPP). The main raw materials consumed by the coal based thermal power plants are coal, water and electricity. The overall average consumption rate of coal is 0.6445 $MT/MWh_{Electricity}$. Most of the thermal power plants recycle the industrial waste water and average water consumption rate (as make up water) due to evaporation loss and bottom ash generation is 2.6147 $M^3/MWh_{Electricity}$ and the specific electricity consumption for 1 MWh production is 140 KWh.

The wastes generated from the coal based thermal power plants are fly ash and bottom ash. The overall average rate of fly ash and bottom ash generation in the thermal power plants are 0.3006 MT/MWh_{TPP} and 0.0750 MT/MWh_{TPP} respectively.

Cement Industries: In West Bengal, there are 48 small, medium and large scale cement grinding plants. It was identified that out of these 48 cement grinding plants, 22 cement grinding plants produce only Portland Pozzolana Cement (PPC) and 18 cement manufacturing plants produce Portland Slag Cement (PSC). However, 8 cement grinding plants produce both of Portland Pozzolana Cement and Portland Slag Cement.

In West Bengal, there are 30 portland pozzolana cement grinding units. The main raw materials consumed by the portland pozzolana cement grinding units are fly ash, clinker, gypsum, water and electricity. The overall average consumption rate of fly ash, clinker and gypsum are 0.3459 MT/MT_{PPC}, 0.6039 MT/MT_{PPC} and 0.0502 MT/MT_{PPC} respectively. Most of the portland pozzolana cement grinding units recycle the industrial waste water and average water consumption rate (as make up water) due to evaporation loss for industrial purpose is 0.0176 M^3/MT_{PPC} and the specific electricity consumption for 1 MT portland pozzolana cement production is 235 KWh.

In West Bengal, there are 26 portland slag cement grinding units. The main raw materials consumed by the portland slag cement grinding units are slag, clinker, gypsum, coal, water and electricity. The overall average consumption rate of slag, clinker, gypsum and coal are 0.4994 MT/MT_{PSC}, 0.4503 MT/MT_{PSC}, 0.0503 MT/MT_{PSC} and 0.0624 MT/MT_{PSC} respectively. Most of the portland slag cement grinding units recycle the industrial waste water and average water consumption rate (as make up water) due to evaporation loss is 0.1894 M^3/MT_{PPC} and the specific electricity consumption for 1 MT portland slag cement production is 250 KWh.

The main solid wastes generated from the portland slag cement grinding units is ash due to combustion of coal as a fuel of slag drier. The overall average rate of ash generation from slag dryer in the portland slag cement grinding units is 0.0148 MT/MT_{PSC}.

Assessment of the Potential of Various Types of Wastes for Recycling or Reuse

Sponge iron industries: Only 12.50% sponge iron industries of West Bengal were recycling the solid wastes – coal char and coal fines but 87.50% SI industries dispose off their wastes for land filling and filling of abandoned mines. The analysis of quantity of the recycling solid wastes generated by the sponge iron industries reveals that only 16.50% coal char and 16.77% coal fines are recycled for power generation in captive power plant i.e. only 12.50% sponge iron industries of West Bengal generate electricity by recycling of coal char and coal fines with mixing of required amount of coal with installation of CFBC boiler. But presently, the net electricity generation by CFBC boiler is only 16.54% in comparison to the net electricity generation potentiality from recycling and recyclable coal char and coal fines of all the sponge iron industries of West Bengal.

It is established from the above discussion that in the CFBC boiler coal char, coal fines and coal are used as raw materials for power generation. Due to combustion of these materials huge quantity of fly ash and bottom ash is generated. This generated ash has great recycling potentiality in the portland pozzolana cement grinding units like the fly ash and bottom ash of thermal power plant. In the portland pozzolana cement grinding units fly ash is used as raw material, which partially reduce the clinker consumption for portland pozzolana cement production. But none of the sponge iron industry of West Bengal recycles the ash generated due to operation of CFBC boiler and the industries use it for land filling only.

From the analysis of the raw materials consumption for portland pozzolana cement (PPC) production, it was revealed that for 1 MT PPC production 3,459 kg (average) fly ash is utilized by the PPC grinding units of the State. Accordingly, it can be said that the recyclable ash generated from the CFBC boiler of all the sponge iron industries of West Bengal if utilized for PPC production, approximately 5, 95,433.15 MT PPC can be produced per month.

Another waste, which is generated from the sponge iron plants, is DRI kiln hot waste gas that also can be used in power generation by installation of waste heat recovery boiler (WHRB). Like the above-mentioned recycling status of the solid wastes of the sponge iron industries of West Bengal, most of the industries are emitting the waste gases in the atmosphere through stack after passing the air pollution control device without any use. Only 14.29% of the sponge iron industries of the State are reusing the hot waste gas for electricity generation, which generated in the DRI kiln during sponge iron production by installation of WHRB boiler.

Though 14.29% of the sponge iron industries of the State are generating power by reusing of DRI kiln hot waste gas but the net electricity generation by installation of WHRB is 18.81% presently with respect to the net electricity generation potentiality by reusing the total hot waste gas generated from 56 sponge iron industries of West Bengal.

If the recyclable solid waste (coal char and coal fines) and DRI kiln hot waste gas of all sponge iron industries of each industrial ecology zone could be utilized for power generation with installation of CFBC and WHRB respectively, after fulfilment of industrial requirement, the sponge iron industries of all the industrial ecology zone can send significant amount of excess electricity to the national or regional grid with huge amount of production cost reduction.

Pig Iron Industries: Only 31.58% of pig iron industries are able to recycle the highly potential recyclable solid waste i.e. Blast Furnace (BF) slag to the PSC grinding units. From the analysis of the raw materials consumption for portland slag cement production, it was revealed that for 1 MT PSC production 4,994 kg (average) blast furnace slag is utilized by the PSC grinding units of the State. Accordingly, it can be said that the recyclable blast furnace slag generated from the pig iron industries if used totally for PSC production, approximately 6,52,820 MT PSC can be produced per month.

The hot Blast Furnace gas (BF gas), generated during the pig iron production process, has utilization in electricity generation by installation of BF gas fired boiler. Most of the pig iron industries of West Bengal are emitting the BF gas in the atmosphere through stack after passing the air pollution control device without any use. Only 15% pig iron industries of West Bengal are reusing the BF gas for electricity generation.

Though 15% pig iron industries of the State are generating power by reusing of hot BF gas but the net electricity generation through blast furnace gas fired boiler is 25.96% in the present situation with respect to the net electricity generation potentiality by reusing the hot BF gas generated by 38 pig iron industries of West Bengal in total.

Cast Iron Foundry: The analysis of 107 cast iron foundries of the State revealed that none of the cast iron foundries recycle or reuse the generated solid wastes i.e. cast iron slag, waste silica sand and dust, which are being dumped within its own premises or use for the land filling purpose. The dust generated in cast iron foundries has potential value of using in brick manufacturing and RMC production unit. The cast iron slag generated during the operation of cupola furnace has an immense potential value for asphalt concrete making, which can be use for road base construction, decorative ground cover, etc. In West Bengal, monthly approximately 13,659 MT cast iron slag is being generated and approximately 68,295 MT asphalt concrete could be made from the recyclable cast iron foundry slag with replacement 20% raw materials of asphalt concrete production.

The cast iron foundries of West Bengal generally recycle the silica sand which is used for casting or moulding of cast iron but at the same time the cast iron foundries also generate waste silica sand at the rate of 0.0932 MT/MT$_{CI}$, which is not recoverable in the cast iron foundry itself. However, the waste silica sand has huge recycling value in asphalt concrete making, where substitution of up to 15% spent sand for conventional asphalt concrete fine aggregate is possible. In West Bengal, monthly approximately 6143.50 MT spent silica sand is being generated and approximately 40,956 MT asphalt concrete could be made from the recyclable waste silica sand.

The dust generated in cast iron unit has potential value of reusing in brick manufacturing and RMC production unit.

Thermal Power Plant: The 16 thermal power plants of West Bengal generate approximately 11,86,374 MT fly ash monthly but only 21.10% fly ash (which partially replace the clinker as a raw material of PPC) is utilized for portland pozzolana cement production and 4.93% is used for fly ash brick manufacturing, RMC and cenosphere production. If the recyclable fly ash would completely use for PPC production, there has a potentiality of additional 25, 08,001.33 MT PPC production per month in the State.

The bottom ash of the thermal power plant also has same potential value of PPC production with respect to the fly ash. But the comparison between the fly ash production in coal based thermal power plants and fly ash consumption in PPC production units showed a massive difference in fly ash consumption due to lack of PPC production units in West Bengal, for that reason there is no demand of bottom ash in PPC production in the State due to high moisture content which create some additional cost of bottom ash drying in the PPC production units and so, the thermal power plants dumping the bottom ash to the ash pond with bearing of transportation and land filling cost. Due to high mixture content of the bottom ash, it is necessary to dry in ash drier of PPC grinding unit against heat generated from burning of coal. At the same time, ash is also generated for combustion of the coal as an additional by product, which could also be used with dry bottom ash as a raw material of PPC production. If this process would follow properly in entire West Bengal there is a potentiality of approximately 8,98,502 MT PPC production monthly by using the bottom ash of thermal power plants and ash from ash dryer of PPC unit.

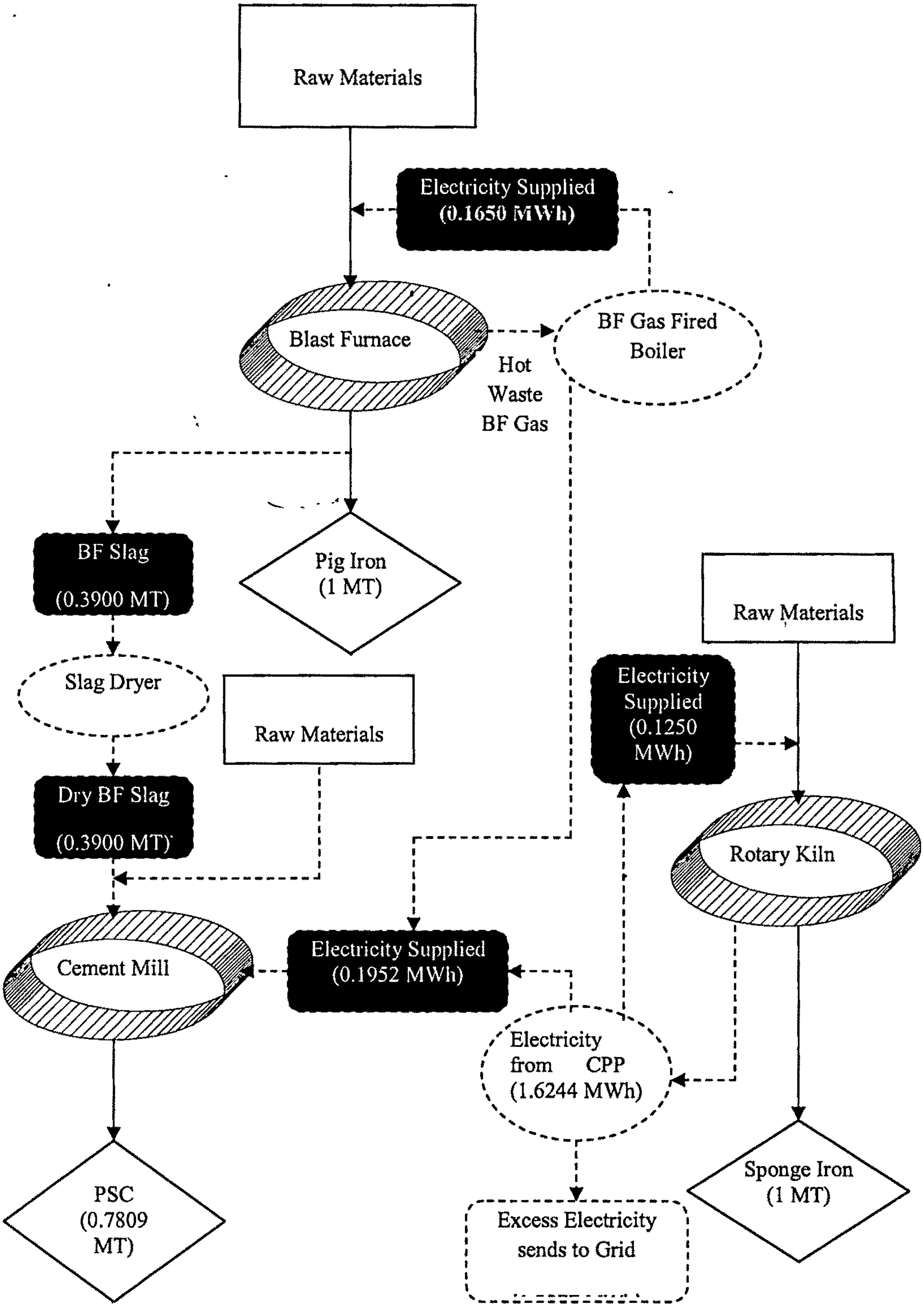
Cement Industries: The portland pozzolana cement grinding units of the West Bengal do not generate any type of solid waste but the portland slag cement grinding units of the State generate slag dryer ash due to combustion of coal for blast furnace slag drying as a solid waste. None of the cement producing industries of the State is reusing the slag dryer ash of PSC producing units.

Monthly 23371.49 MT PPC can be produced from the slag dryer ash generated in the PSC production unit of the State.

Model for Operationalizing the Integrated Industrial Ecology Concept

In this section initially various industry specific models have been evolved for operationalizing the industrial ecology concept. Finally an integrated model for various types of industries located in particular industrial ecology zones has been evolved. The implementation of proposed integrated industrial ecology model for operationalizing the IE concept would not only further reduce the production cost significantly but also provide additional avenues for recycling and reuse of the various types of wastes in the same unit or in the other units leading to significant reduction in health and environmental risks. In this study, one integrated industrial ecology model (IIEM) (Figure 1) evolved for the operationalization of IE concept in sponge iron, pig iron and portland slag cement grinding units is presented in subsequent section.

This model have been evolved on the basis of three industry specific industrial ecology models, which describes the recycling and reuse potentiality and possibility of the recyclable wastes within the sponge iron, pig iron and portland slag cement grinding unit of an integrated plant. The model shows that the electricity generated by reusing of solid wastes - coal char and coal fines of sponge iron units in CFBC boiler and by recycling of hot waste gas of DRI & BF gas in the boilers, would completely fulfill the electricity requirement of sponge iron, pig iron and portland slag cement grinding units and the excess electricity could be sold to the national/regional grid. The generated dust from sponge iron and pig iron units would reuse for sinter manufacturing in the process. The ash generated in the CFBC boiler and BF slag dryer would be taken by portland pozzolana cement grinding unit. The blast furnace slag of pig iron unit would be recycled as raw materials of portland slag cement grinding unit.


Raw Materials
Electricity Supplied (0.1650 MWh)
Blast Furnace
BF Gas Fired Boiler
Hot Waste BF Gas
BF Slag (0.3900 MT)
Pig Iron (1 MT)
Raw Materials
Slag Dryer
Raw Materials
Electricity Supplied (0.1250 MWh)
Dry BF Slag (0.3900 MT)
Rotary Kiln
Cement Mill
Electricity Supplied (0.1952 MWh)
Electricity from CPP (1.6244 MWh)
PSC (0.7809 MT)
Excess Electricity sends to Grid
Sponge Iron (1 MT)

Cost-Benefit Analysis of IIEM

This section presents the cost-benefit analysis of the integrated industrial ecology model depicted in the earlier section. With the implementation of this model, it can be ascertained that all the integrated industries would reduce their production cost with recycling and reuse of the various types of recyclable wastes in the same industry or in the other industries leading to the significant increase in the profit margin.

Table 2 indicates the cost-benefit analysis of IIEM, which presents a comparative analysis between conventional method of sponge iron, pig iron & portland slag cement production and production of the same with recycling of waste with introduction of integrated sponge iron – pig iron – portland slag cement process. If this integrated process is implemented, it is estimated that for 1 MT sponge iron production, 1 MT pig iron production and subsequently 0.7809 MT portland slag cement production, 2.56% production cost would be reduced due to operationalization of IE concept with respect to recycling of waste in individual industry and 20.86% production cost would be reduced as compare to without recycling of waste in integrated industry or without recycling of waste in individual industry respectively. The reasons behind the reduction in production cost of the integrated plant with recycling of wastes are as follows:

- Electricity generated in WHRB (recycling of hot waste heat) and CFBC (recycling of coal char & coal fines) of sponge iron unit would fulfill the electricity requirement of sponge iron production unit completely,
- Electricity generated in blast furnace gas fired boiler of pig iron unit would fulfill the electricity requirement of pig iron production unit fully,
- Electricity generated in WHRB & CFBC of sponge iron unit and blast furnace gas fired boiler of pig iron unit would fulfill the electricity requirement of portland slag cement grinding unit completely,
- The excess electricity generated from the captive power plant of the integrated process would be sold to the national or regional grid with some financial benefit, which would reduce the production cost,
- Ash generated from CFBC would be transported to portland pozzolana cement grinding unit, which would reduce the transportation and disposal cost of CFBC ash,

- Blast furnace slag of pig iron unit would be transferred to the portland slag cement grinding units, which would eliminate the transportation and disposal cost of blast furnace slag,
- The rotary kiln and blast furnace generated dust would be reused for sinter manufacturing in the process, and
- Lastly, due to introduction of the integrated process, the transportation cost of blast furnace slag for portland slag cement production (used as a raw material) would be eliminated fully from the production cost.

Table 2: Cost-benefit Analysis of IIEM

Sl No.	Particulars	Conventional Method		With Waste Recycling	
		Quantity	Price (Rs.)	Quantity	Price (Rs.)
	1 MT Sponge Iron Production				
1.	Iron Ore Consumption (MT)	1.9914	4799.27	1.9914	4799.27
2.	Coal Consumption (MT)	1.6590	2687.58	1.6590	2687.58
3.	Dolomite Consumption (MT)	0.0529	22.48	0.0529	22.48
4.	Water Consumption (M^3)	2.1594	0.11	2.1594	0.11
5.	Electricity Consumption (MWh)	0.1250	625.00	0.1250	-
6.	Electricity generated by Recycling of Waste (MWh)	-	-	1.6244	2951.53
7.	Excess Electricity sell to the Grid (MWh)	-	-	1.3877	(-) 4440.64
8.	Transportation & Disposal Cost of Coal Char (Rs.)	0.4002	51.93	0.4002	-
9.	Transportation & Disposal Cost of CFBC Ash (Rs.)	-	-	0.6384	-
10.	Transportation & Disposal Cost of Dust (Rs.)	0.0702	9.46	0.0702	-
	Total	-	**8195.83**	-	**6020.33**

	1 MT Pig Iron Production				
1.	Iron Ore Consumption (MT)	1.8668	4498.99	1. 8668	4498.99
2.	Hard Coke Consumption (MT)	0.7400	5772.00	0.7400	5772.00
3.	Limestone Consumption (MT)	0.1297	27.89	0.1297	27.89
4.	Manganese Consumption (MT)	0.0341	347.82	0.0341	347.82
5.	Quartzite Consumption (MT)	0.0328	11.64	0.0328	11.64
6.	Water Consumption (M^3)	2.1021	0.11	2.1021	0.11
7.	Electricity Consumption (MWh)	0.1650	825.00	0.1650	-
8.	Electricity generated from Waste Gas (MWh)	-	-	0.2305	371.11
9.	Transportation & Disposal Cost of BF Slag (Rs.)	0.3900	49.65	0.3900	-
10.	Transportation & Disposal Cost of Dust (Rs.)	0.0591	7.96	0.0591	-
	Total	-	**11541.06**	-	**11029.56**
	0. 7809 MT Cement Production	**PC**		**PSC**	
1.	Clinker Consumption (MT)	0.7419	2299.87	0.3516	1089.96
2.	Gypsum Consumption (MT)	0.0390	15.60	0.0393	15.72
3.	BF Slag Consumption (MT)	-	-	0.3900	-
4.	Water Consumption (M^3)	0.0156	0.001	0.1479	0.01
5.	Electricity Consumption (MT)	0.1913	956.50	-	-
6.	Electricity taken from CPP of SI & PI Unit (MWh)	-	-	0.1952	-
7.	Coal Consumption for Slag Dryer (MT)	-	-	0.0330	53.46
8.	Transportation & Disposal Cost of Ash Generated from Slag Dryer (Rs.)	-	-	0.0132	-
	Total	-	**3271.97**	-	**1159.15**
Production Cost Reduction due to Operationalization of IE Concept w.r.t. without Recycling of Waste in Integrated Industry (Rs.)					4799.82 *(20.86%)*
Production Cost Reduction due to Operationalization of IE Concept w.r.t. with Recycling of Waste in Individual industry (Rs.)					479.17 *(2.56%)*
Production Cost Reduction due to Operationalization of IE Concept w.r.t. without Recycling of Waste in Individual industry (Rs.)					4799.82 *(20.86%)*

Conclusion & Recommendation

The present study has evolved techno-economically viable integrated model for conservation of natural resources in industrial production and reusing & recycling of wastes for effective environmental management to achieve the goal of sustainable development.

It has also established that through operationalization of IE concept (where IEZ are being considered as a closed loop system instead of open loop in which waste are disposed off into the environment in spite of having the enormous recycling and reuse potential), the cost of the production can be reduced (up to approx. 40%) and accordingly, the profit margin can be increased substantially.

It is recommended that the future industrial development planning should be holistic, considering the nature and type of industries to be developed in any planning region (IEZ) must commensurate with IE concept, for not only optimum/efficient natural resources utilization but also for enabling industries to compete at global market by leveraging the bottomlines of industrial production and business.

References:

Allenby, B. R.; D. J. Richards (1994) The Greening of Industrial Ecosystems (ed. Allenby, B. R., Richards, D. J., Frosch, R. A.), Washington: National Academy Press, pp. 1 20 (www. ejeafche.uvigo.es accessed on 21.06.2010).

West Bengal Pollution Control Board (2007-2008) *Annual Report,* Department of Environment, Government of West Bengal.

Antiohos, S. K. and S. Tsimas (2007) *A Novel Way to Upgrade The Coarse Part of A High Calcium Fly Ash for Reuse Into Cement Systems, Waste Management,* Vol. 27, pp. 675–683.

Bouzoubaa, N.; M. H. Zhang; V. M. Malhotra (2001) *Mechanical Properties and Durability of Concrete made with High-Volume Fly Ash Blended Cements using a Coarse Fly Ash, Cement and Concrete Research,* Vol. 31, pp. 1393-1402.

Cheerarot, R.; C. Jaturapitakkul (2004) *A Study of Disposed Fly Ash from Landfill to Replace Portland Cement, Waste Management,* Vol. 24, pp. 701-709.

Das, B.; S. Prakash; P. S. R. Reddy; V. N. Misra (2007) *An Overview of Utilization of Slag and Sludge from Steel Industries, Resources, Conservation and Recycling*, Vol. 50 (1), pp. 40-57.

Gun, Gupta and Dasgupta (2002) *Fundamentals of Statistics*, Kolkata: The World Press Private Limited, Volume II, pp. 591-592.

Hiltunen, A. (1998) *Waste Management as a Business in Integrated Steel Making, Proceedings Gorham/Intertech's 13th International Iron & Steel Development Forum* – Managing Steel Mill Wastes and By-Products: Crisis and Opportunity. Antwerp, Belgium, p. 13.

Kalyoncu, R. S. (2000) Slag – Iron and Steel, *U.S. Geological Survey Minerals Year Book* (www. minerals.usgs.gov accessed on 01.05.2010).

Kumar, S.; R. Kumar; A. Bandopadhyay; T. C. Alex; B. R. Kumar; S. K. Das; S. P. Mehrotra (2008) *Mechanical Activation of Granulated Blast Furnace Slag and its Effect on the Properties and Structure of Portland Slag Cement, Cement and Concrete Composites*, Vol. 30 (8), pp. 679-685.

Modesto, M.; S. A. Nebra (2009) *Exergoeconomic Analysis of the Power Generation System Using Blast Furnace and Coke Oven Gas in Brazilian Steel Mill, Applied Thermal Engineering*, Vol. 29 (11-12), pp. 2127-2136.

NSA (2006) *The Slag Sector in the Steel Industry, The Japan Iron and Steel Federation* (www.slg.jp accessed on 10.07.2010).

Pandit, A.; B. M. Sarangi; A. K. Babu; M. K. Sheshadri (2005) *Coal Based Sponge Iron Industry – A Prime Mover to Enhance Steel Making Capacities in India?* (www.steelworld.com accessed on 17.05.2010).

Parker, J. A. L.; G. K. Loveday (1996) *Recovery of Metal from Slag in Ferro Alloy Industry, Proceedings in International Conference on Hidden Wealth*, Johannesburg: South African Institute of Mining and Metallurgey, pp. 7-15.

Scott, P. D. (2008) *Techno Economics of Recovering Ferro Alloys from Dust and Slag* (www.atoll.co.za accessed on 08.06.2010).

Wu, S.; Y. Xue; Q. Ye; Y. Chen (2007) *Utilization of Steel Slag as Aggregates for Stone Mastic Asphalt (SMA) Mixtures, Building and Environment*, Vol. 42 (7), pp. 2580-2585.

Green Development of West Bengal

- Miles to Go

S.P.Mukherjee[*]

Abstract

In this article the author has emphasized on the concept of Green Development. In the beginning the link between the terms economic growth, human development, environmental protection and green development has been highlighted. The latter half focuses on the use of solar energy, industrial ecology, and bicycles to reduce pollution in West Bengal .When addressed properly then these will yield fruitful results. Finally, it is the integration of economic, social and environmental concerns and related environment friendly practices which will help in attaining Green Development.

Introduction

Green Economy, Green GDP (Gross Domestic Product), Green Development and similar other phrases including Green Wash – coined recently – do not admit of unequivocal definitions or perceptions, even among those proponents of the underlying philosophy who are identified with these phrases. These concepts are sometimes subsumed in the broad concept of sustainable development, though Green Development may not be necessarily sustainable.

Beginning with the Report of the Club of Rome entitled 'Limits to Growth : A Strategy for Survival' published in 1972, there has been a plethora of published materials followed by an unending series of international meetings and resolutions to express the concerns of social and political leaders and activists about the continuing depletion of natural resources and damage to the environment (that support human life and activities) through the ever-increasing production and consumption of goods and services.

---

[*] Former Professor, Department of Statistics, University of Calcutta, India.

While some thinkers believe that 'sustainability' is a myth, some voices have been raised to assert that all these constitute a vaguely charted dream of everlasting wealth pursued by the rich with too little concern for the poor.

The concept of sustainability emerged from existential anxieties that accompanied the phenomenal rise in living standards enjoyed by the developed world during the second half of the last century.

Development involves use of natural, financial and human capital, and it takes place within an environment that supports human life as well as all human activities that lead to development. Sustainable Development (sometimes comprehended in terms of ELF—Environment, Local people and Future) enjoins on the present generation the need to reduce the depletion of natural resources and the damage done to our environment such that production of goods and services to meet the needs of the present generation does not affect the ability of our future generations to meet their needs.

Sustainable Development usually refers to three pillars--economic growth, human development and environmental protection. These can be examined at local, national, regional or global levels. But international co-operation is needed to make headway at any level.

Green Development

The cumulative effect of an inverse relationship between economic growth and sustainability has forced development planners to think of new measures of economic growth, like the Green Gross Domestic Product that internalises the 'environmental costs'.

The rational assumption that the existing stock of natural resources, even after attempts to replenish the stock that gets continuously degraded or depleted, is only finite implies necessarily that human needs have to be contained, putting a cap on consumption of goods and services and thereby on the production-related damage done to our environment. This fundamental implication of consumption–driven life-style has to be fully realized.

Green Development initially emerged as an exercise in land use planning, embracing site-specific green building concepts, architecture, landscape planning, community building concepts, cemetery development, passive solar building design, intelligent building design with moving solar panels, automatic opening and closing air vents, traffic calming and the like. Green Development may not necessarily be sustainable, in cases where measures to arrest depletion or degradation of natural capital and /or environmental damage are too costly to initiate and/or to sustain.

Green Development is associated with Green Economy, which has the following—among other—characteristics:

1. Low carbon energy production
2. Efficient life-cycle use of materials and products and
3. Equitable improvement in living standards without eroding environmental assets.

These characteristics can be understood unequivocally and can be incorporated into the economy in terms of appropriate policies and plans. In fact, the first requires a comprehensive analysis of the demands for energy consistent with an accepted cap on consumption of goods and services, followed by cost-benefit analysis for alternative sources of energy like hydro-, wind-, solar-, nuclear-, etc. as are feasible in a given context. The second characteristic calls for a ban on the current policy of 'planned obsolescence' pursued by Industry and on the existing practice of 'use and throw' adopted by consumers who can afford to do so. (Such consumers are welcomed by Industry in terms of an expanding market and a so-called strong economy.) The third and the most important characteristic grimly remind us of the hard fact that poverty propels poor people to deplete easily accessible environmental assets for their bare livelihood.

Let us note that 'a light purse is a heavy curse' implies that a sizeable below-poverty-line population is a big drag on development – the outcome of a faulty planning of Economic Development that did not recognize inequality-reduction as a prime objective and the cause for low socio-cultural and political development. Equity in living standards and not just increase in GDP or even in GDP per capita is the mandate of a Green Economy.

Meanwhile, environmentalists are concerned that the current vision of a green economy permits continued growth without proper focus on environmental limits. For example, it is possible that increased efficiency in resource utilization may simply encourage greater consumption. The direction given by a green economy may prove to be a necessary but insufficient condition for sustainable development.

Imperatives of Green Development

Any process of development and particularly sustainable development calls for a comprehensive and imaginative planning that starts with a pragmatic and modest set of demands, envisages efficient use of materials and energy in production processes, requires industry to discard the present policy of Planned Obsolescence as also the current practice of 'use and throw', emphasizes on sustainable agriculture, and supports conservation of ecosystems.

There is consensus that a transition to a Green Economy requires significant up-front investment, though this will eventually lead to gains in employment and reduced risk of economic shocks.

Green Development has to focus on efficient use of by-products and wastes from agriculture as well as industry. This may require investing on modernisation of production apparatus and/or production processes.

The Case of West Bengal

A serious search for alternate sources of energy is not much evident in West Bengal, nor have there been serious thoughts and actions to reduce energy consumption. Much remains to be done to develop and utilize power from hydel projects or windmill hubs or even solar parks which put to use a large number of solar panels in order to generate a reasonable amount of energy. The Teesta project has been able to generate only a fraction (around 15%) of the targeted output. Modern rice mills can separate rice grains from husk as well as bran, while the older mills which are really husking mills mix up the latter two. This mixture has a low energy yield, though bran by itself can be converted through solvent extraction to edible oil. Most rice mills in the state – some operating without licenses – are old and need modernization.

There have been many unimaginative and incomplete plans to use waterways for passenger and goods traffic. None could so far materialize though some money has been squandered, in the absence of sincere and assertive programmes to make the waterways navigable and to put in place the accessories and facilities needed for the purpose of promoting river transport.

Use of solar energy for heating and lighting purposes in public buildings, besides private ones, should be promoted- in terms of both incentives and mandates. Similarly, use of solar lights on streets as also in campuses of public and private institutions should be increased substantially.

This may also require safe disposal of automobiles used for several years. Use of bicycles for personal movements has been on the rise in several Western European countries and people are advised and enabled to avoid fuel-driven vehicles. Of course, what we need to emulate this practice here is to provide safe and convenient road spaces for free movement of these pedalled vehicles. While we have these vehicles to carry passengers in villages, more and more of these vehicles are getting motorized to lessen fatigue of the drivers.

It is true that land is a resource needed by Industry and that Industry plays a crucial role in Development. And land is becoming scarcer as rapid urbanization takes place. This calls for a very careful land-use planning and Industry should possibly take care of wastelands only. In fact, 'waste' has to be comprehended as time-specific and as use-free. We should apply principles of industrial ecology to build up closed loop industrial hubs which are not meant for only specific type of industries — as we are currently having — but accommodate units of different industry types to make efficient use of wastes and efficient absorption of pollutants within themselves. This is mandated by the principles of industrial metabolism.

Pollution from vehicles is a major issue. To reduce pollution vehicular traffic must be curbed. For example in Aizawl (Mizoram) there is a provision under which each vehicle must be off the road one day per week. To put this into effect, registration number of each vehicle is noted and a particular day of the week is assigned to it when it will be off the road. This model can also be applied, with necessary modification, in West Bengal.

What is needed as the most important impetus to move towards green development is an over-all development plan that integrates economic, social and environmental concerns and measures to address them on a holistic basis.

Emerging Trends of Green Marketing in India in the Context of Global Scenario

Kaushik Kundu [1]

Abstract

Green marketing is the marketing of products that are presumed to be environmentally safe. It incorporates a broad range of activities, including product modification, changes of the production process, packaging changes, as well as modifying advertising. It will come with drastic change in the world of business if all nations will make strict roles because green marketing is essential to save world from pollution. From the business point of view a clever marketer is one who not only convinces the consumer, but also involves the consumer in marketing his product. Green marketing should not be considered as just one more approach to marketing, but has to be pursued with much greater vigor as it has societal and environmental dimensions. Marketers also have the responsibility to make the stakeholders aware about the need and the advantages of green products. The green marketers will have full support of the government, and the consumers also will not mind paying more for a cleaner and greener environment.

Introduction

According to the American Marketing Association, "green marketing is the marketing of products that are presumed to be environmentally safe." Thus green marketing incorporates a broad range of activities, including product modification, changes to the production process, packaging changes, as well as modifying advertising. Yet defining green marketing is not a simple task where several meanings intersect and contradict each other; an example of this will be the existence of varying social, environmental and retail definitions attached to this term. Other similar terms used are Environmental Marketing and Ecological Marketing.

---

[1] Assistant Professor, School of Management and Social Science, Haldia Institute of Technology, India.

Green, environmental and eco-marketing are parts of the new marketing approaches which do not just refocus, adjust or enhance existing marketing thinking and practice, but seek to challenge those approaches and provide a substantially different perspective. In more detail green, environmental and eco-marketing belong to the group of approaches which seek to address the lack of fit between marketing as it is currently practiced and the ecological and social realities of the wider marketing environment.

The Fundamental Concept of Green Marketing

The term Green Marketing came into prominence in the late 1980s and early 1990s. The American Marketing Association (AMA) held the first workshop on "Ecological Marketing" in 1975. The proceedings of this workshop resulted in one of the first books on green marketing entitled "Ecological Marketing".

The Corporate Social Responsibility (CSR) Reports started with the ice cream seller Ben & Jerry's where the financial report was supplemented by a greater view on the company's environmental impact. In 1987 a document prepared by the World Commission on Environment and Development defined Sustainable Development as meeting "the needs of the present without compromising the ability of future generations to meet their own need", this became known as the Brundtland Report and was another step towards widespread thinking on sustainability in everyday activity. Two tangible milestones for wave of green marketing came in the form of published books, both of which were called Green Marketing. They were by Ken Peattie (1992) in the United Kingdom and by Jacquelyn Ottman (1993) in the United States of America.

According to Jacquelyn Ottman, (author of "The New Rules of Green Marketing: Strategies, Tools, and Inspiration for Sustainable Branding" (Greenleaf Publishing and Berrett-Koehler Publishers, February 2011)) from an organizational standpoint, environmental considerations should be integrated into all aspects of marketing — new product development and communications and all points in between. The holistic nature of green also suggests that besides suppliers and retailers new stakeholders be enlisted, including educators, members of the community, regulators, and NGOs. Environmental issues should be balanced with primary customer needs.

The past decade has shown that harnessing consumer power to effect positive environmental change is far easier said than done. The so-called "green consumer" movements in the U.S. and other countries have struggled to reach critical mass and to remain in the forefront of shoppers' minds. While public opinion polls taken since the late 1980s have shown consistently that a significant percentage of consumers in the U.S. and elsewhere profess a strong willingness to favor environmentally conscious products and companies, consumers' efforts to do so in real life have remained sketchy at best. One of green marketing's challenges is the lack of standards or public consensus about what constitutes "green," according to Joel Makower, a writer on green marketing. In essence, there is no definition of "how good is good enough" when it comes to a product or company making green marketing claims. This lack of consensus—by consumers, marketers, activists, regulators, and influential people—has slowed the growth of green products, says Makower, because companies are often reluctant to promote their green attributes, and consumers are often skeptical about claims.

Despite these challenges, green marketing has continued to gain adherents, particularly in light of growing global concern about climate change. This concern has led more companies to advertise their commitment to reduce their climate impacts, and the effect this is having on their products and services.

Conceptual Development of Green Marketing in Literature

The green awareness began in between of the 1960s and early 1970s with increasing concern about the negative impact of consumption pattern, impact of economic and population growth on the environment (Cohen, 2001). But, a serious concern of green marketing appeared in the late 1980s with a rapid increase in the consumer awareness for the green products. The increasing awareness in environment friendly products, their willingness to pay for these products, increased concern for these products which encouraged companies to show interest in the green marketing (Peattie and Crane, 2005). Green marketing practices generally promoted as the genuine concern for the nature of inputs as well as outputs waste reduction and the impact of these upon the environment and society as a whole both in present & future conditions (Walker and Hanson, 1998). According to American Marketing Association, green marketing is the marketing of products that are presumed to be environmentally safe. It includes various activities like waste reduction, changes in the product, and modifications in the communication mix. During 1990s, the concern for environment increased and resulted in to increasing challenges for the companies (Johri and Sahasakmontri, 1998).

Brahma, M. & Dande, R. (2008), The Economic Times, Mumbai, had an article which stated that, Green Ventures, India is a subsidiary of New York based asset management firm Green Ventures International. The latter recently announced a $300 million India focused fund aimed at renewable energy products and supporting trading in carbon credits. Founder & CEO of Emergent Ventures India (EVI) Vinod Kala says he realized in 2004 that there is huge business potential in environment. He further adds that financial investors are increasingly looking at Green Technology as profit opportunity than only a morally right thing to do, but there are dozens of entrepreneurs who have found that the capital expenditure involved in such projects are overwhelming and funds too hesitant to invest in them. The US and the EU have asked both India and China to reduce their baseline emissions, which should get implemented by 2020. Mr. Bharathwaj says that once that happens and the government adopts more stringent policies for curbing carbon emissions, Clean Technology ventures would assume greater importance in the country and as a result there would be more investment interest within the sector. Chaudhary, R., and Bhattacharya, V. (2007), in their article on "Clean Development Mechanism: Strategy for Sustainability and Economic Growth" published in Indian Journal for Environmental Protection, state that, the Clean Development Mechanism (CDM), a co-operative mechanism established under the Kyoto protocol, has the potential to assist developing countries in achieving sustainable development by promoting environment friendly investment from industrialized country governments and businesses. The funding channeled through the CDM should assist developing countries in reaching some of their economic, social, environmental, and sustainable development objectives, such as cleaner air and water, improved land use, accompanied by social benefits, such as rural development, employment, and poverty alleviation and in many cases, reduced dependence on imported fossil fuels. Thus environment friendly strategies become the key factors for CDM projects.

Uberoi (2007), in his book on Environmental Management states that, the government at the centre and at the state level and their agencies should become proactive vis-à-vis environment. The environmental problems cannot be tackled without a sound proactive policy by the government. Intervention of the government is required on continuing basis and not on one-time legislation and its implementation. Corporate behavior can be regulated or altered through state policies. The policies of government can shape the role of companies and that of the managers for the larger interest of society. The corporate world in India, under new economic order of liberalization and globalization has to increase its share of world trade and in this effort one major impact of rising trades would be on environment and resources. The business world internationally has begun to acknowledge that environment is playing an important role in all facets of business. A survey by Mckinsey and company revealed that: (1) 92% of Chief Executive Officers (CEOs) believe that environment should be of top management priority; (2) 35% CEOs believe that their companies have adopted strategies to anticipate impacts of environment on business. Polonsky and Alma (2008), in their edited book titled "Environmental Marketing – Strategies, Practice, Theory and Research", discuss the role of marketing in improving our environment. The book states that role of marketing in the development process is well recognized (Kinsley 1982; Riley et al. 1983; Dholakia 1984; Carter 1986; Kotler 1986). Much of the economic activity is triggered by the marketing process that offers and stimulates consumption opportunities to satisfy human needs and wants. However, critical role of marketing in development will be appreciated only through sustainable marketing; it meets the needs of the present without compromising the ability of future generations to meet their own needs. This means that it might have to shed its present profligacy that encourages an unsustainable development path. A marketing approach that aims at serving the material wants of consumers through an ever increasing volume of goods without any attempt to maximize life quality (Kotler, 1988), draws too heavily, and too quickly, on already overdrawn environmental resources and is likely to mortgage the future. Life quality represents not only the quantity and quality of consumption goods and services but also the quality of the environment. Clearly, marketing has to assume a more responsible role for sustainable development. It further states that the concept of a "socio-ecological product" has to extend our understanding that environmental consequences (the product's aggregate impact on everyone affected by its use) are more important determinants of its acceptability than either user satisfaction or corporate profitability (Cracco and Rostenne 1971). The true socio-ecological product is one that becomes a consumer's first choice, since it meets his/her consumption need for a healthy and sustainable physical environment. Sustainable development can be achieved only by proactive corporate marketing and active government intervention.

Dutta, B. (2009, January) in his article on Green Marketing titled "Sustainable Green Marketing: The New Imperative published in Marketing Mastermind" states that Green Marketing involves developing good quality products which can meet consumer needs and wants by focusing on the quality, performance, pricing and convenience in an environment-friendly way. It has gained momentum in the context of global warming and climate change and this, in turn, has forced many companies to incorporate the principals of Green Marketing. Firms need to explore every opportunity to enhance their products/services in terms of quality, performance, social responsibility and environment-friendliness. Barkar is of the view that, Companies need to believe first that Green Marketing can work and make diligent efforts to make necessary product improvements, which deliver performance, and are marketable and profitable. Unruh, G. And Ettenson, R. (2010) in their research article titled, "Growing Green: Three smart paths to developing sustainable products", published in Harvard Business Review, is for executives who believe that developing green products make sense for their organisation and need to determine the best path forward. The authors have introduced and described three broad strategies that companies can use to align their green goals with their capabilities.

Some Concepts Related to Green Marketing

a) Ecological Marketing

Ecological marketing was based on the idea that environmental protection and resource conservation can be better advanced through less regulation by the public sector and more enterprise in the private sector. This idea, in turn, is based on the premise that the ecologically concerned consumer is a legitimate but largely unused market segment — one that is identifiable, accessible and measurable. In the 1970s the importance of a small number of environmental issues likes oil use or pollution for a narrow range of industries (for example cars and chemicals) was framed as something that was relevant to engineers, lawyers and marketers within companies.

Originally proposed at the American Marketing Association first conference on ecological marketing in 1975, the idea was compatible with the antiregulatory mood of these days in the U.S. It found support at the 1979 conference, who felt that government and business should strike a better balance in the division of responsibility for the management of negative social externalities.

b) Green Environmental Marketing

Unfortunately, a majority of people believe that ecological (green) marketing refers solely to the promotion or advertising of products with environmental characteristics. Terms like phosphate free, recyclable, refillable, ozone friendly and environmentally friendly are some of the things consumers most often associate with green marketing. While these terms are green marketing claims, in general green marketing is a much broader concept, one that can be applied to consumer goods, industrial goods and even services. Thus, green marketing incorporates a broad range of activities, including product modification, changes of the production process, packaging changes, as well as modifying advertising. Green marketing came into prominence in the late 1980s and early 1990s; it was first discussed much earlier. According to Dainora Grundey and Rodica Milena Zaharia "Green or Environmental Marketing consists of all activities designed to generate and facilitate any exchanges intended to satisfy human needs or wants, such that the satisfaction of these needs and wants occurs, with minimal harmful impact on the natural environment ".

c) Greenhouse Gas Reduction Market

The emerging greenhouse gas reduction market can potentially catalyze projects with important local environmental, economic, and quality-of-life benefits. The Kyoto Protocol's Clean Development Mechanism (CDM), for example, enables trading between industrial and developing nations, providing a framework that can result in capital flows to environmentally beneficial development activities. Although the United States is not participating in the Kyoto Protocol, several US programs enable similar transactions on a voluntary and regulatory basis.

While international trade in greenhouse gas reductions holds substantial promise as a source of new funding for sustainable development, this market can be largely inaccessible to many smaller-scale projects, remote communities, and least developed localities. To facilitate participation and broaden the benefits, several barriers must be overcome, including: a lack of market awareness among stakeholders and prospective participants; specialized, somewhat complicated participation rules; and the need for simplified participation mechanisms for small projects, without which transaction costs can overwhelm the financial benefits of participation. If the barriers are adequately addressed, greenhouse gas trading can play an important role supporting activities that benefit people's lives and the environment.

d) The Concept of Green-washing

The term "green-washing" refers to all industries that adopt outwardly green acts with an underlying purpose to increase profits. The primary objective of green-washing is to provide consumers with the feeling that the organization is taking the necessary steps to responsibly manage its ecological footprint. In reality, the company may be doing very little that is environmentally beneficial. The term green-washing was first used by environmentalist Jay Westerveld when objecting to hotelier's practice of placing notices in hotel rooms which asked their quests to reuse towels to "save the environment". Westerveld noted that there was little else to suggest that the hoteliers were interested in reducing their environmental impacts, and that their interest in washing fewer towels seemed to be motivated by a concern to save costs rather than the environment. Since then green-washing has become a central feature of debates about marketing communications and sustainability, with "awards" for green-washing established and numerous campaigns, law and advices developed in an attempt to reduce or curb it.

Effectiveness of Green Marketing Approach

The popularity of such marketing approach and its effectiveness is hotly debated. Supporters' claim that environmental appeals are actually growing in number–the Energy Star label, for example, now appears on 11,000 different companies' models in 38 product categories, from washing machines and light bulbs to skyscrapers and homes.

However, despite the growth in the number of green products, green marketing is on the decline as the primary sales pitch for products. On the other hand, Roper's Green Gauge shows that a high percentage of consumers (42%) feel that environmental products don't work as well as conventional ones. This is an unfortunate legacy from the 1970s when shower heads sputtered and natural detergents left clothes dingy. Given the choice, all but the greenest of customers will reach for synthetic detergents over the premium-priced, proverbial "Happy Planet" any day, including Earth Day. New reports however show a growing trend towards green products.

One challenge green marketers -- old and new -- are likely to face as green products and a message become more common is confusion in the marketplace. "Consumers do not really understand a lot about these issues, and there's a lot of confusion out there," says Jacquelyn Ottman. Marketers sometimes take advantage of this confusion, and purposely make false or exaggerated "green" claims. Critics refer to this practice as "green washing".

The Indian Scenario of Green Marketing

Nike is the first among the shoe companies to market itself as green. It is marketing its Air Jordan shoes as environment-friendly, as it has significantly reduced the usage of harmful glue adhesives. Kansai Nerolac Paints has been at the forefront of paint manufacturing for more than 88 years pioneering a wide spectrum of quality paints. Kansai Nerolac has worked on removing hazardous heavy metals from their paints – among this lead being the most prominent metal. Kansai Nerolac does not add any lead or other such heavy metals in its manufacturing process. Dell has been one of the vendors who focus on producing green IT products. They have a strategy called "Go green with Dell" to sell these products in the market. It also comes in an eco-friendly packaging with a system recycling kit bundled along. Talking about the green commitments of the company, Sameer Garde, Country GM, Dell India, says, "Dell is also actively pursuing green innovations that will be of value in 2009 from data-center efficiency to the use of eco-friendly materials for everything from chassis design to product packaging. Eco Hotels (Ecotels) is a certification system promoted by Hospitality Valuation Services (HVS) International. This system is based on 5 main criteria: environmental commitment, solid waste management, energy efficiency, water conservation, and employee education/community involvement. In India we have Eco-hotels like Orchid, Rodas, Raintree etc. believing and practicing green marketing. According to Harish Tiwari of Infinity Infomatic Pvt Ltd, a well known distributor, who says, "We don't find any difficulty in selling green products because the knowledge for these products has increased in us as well in customer. They are ready to pay higher for these products once they convinced". In May 2007, IBM launched Project Big Green to help clients around the world improve the efficiency of IT and better optimize their data center resources. IBM has software and services technologies to help businesses reduce data center energy consumption and cut energy costs by more than 40 percent.

Organizations perceive environmental marketing as an opportunity to achieve its objectives. Firms have realized that consumers prefer products that do not harm the natural environment as also the human health. Firms marketing such green products are preferred over the others not doing so and thus develop a competitive advantage, simultaneously meeting their business objectives. Organizations believe they have a moral obligation to be more socially responsible. This is in keeping with the philosophy of CSR which has been successfully adopted by many business houses to improve their corporate image. Firms in this situation can take two approaches:

- Use the fact that they are environmentally responsible as a marketing tool.
- Become responsible without prompting this fact.

Governmental bodies are forcing firms to become more responsible. In most cases, the government forces the firm to adopt policy which protects the interests of the consumers. It does so in following ways:

- Reduce production of harmful goods or by products
- Modify consumer and industry's use and /or consumption of harmful goods; or
- Ensure that all types of consumers have the ability to evaluate the environmental composition of goods.

Cost factors associated with waste disposal or reductions in material usage forces firms to modify their behavior. With cost cutting becoming part of the strategy of the firms it adopts green marketing in relation to these activities. It may pursue these as follows:

- A firm develops a technology for reducing waste and sells it to other firms.
- A waste recycling or removal industry develops.

Introduction of CNG in Delhi

New Delhi, the capital of India, was being polluted at a very fast pace until Supreme Court of India forced a change to alternative fuels. In 2002, a directive was issued to completely adopt CNG in all public transport systems to curb pollution.

Gas Tech Electronic Products (Pvt) Ltd. has invented LPG Kit for motorcycles/scooters (4 stroke and 2 stroke).Can be fitted in 50 cc to 375 cc air cooled , single cylinder 2 stroke as well 4 stroke vehicles with cent % fuel efficiency, with clean exhaust and zero pollution. The following figure shows the amount of pollution caused by different types of vehicles in Delhi, of which maximum pollution is caused by two wheelers. 38% of particulate matter and 61% of hydrocarbons are released by two wheelers alone. Thus the use of LPG kit for motorcycles/scooters will reduce pollution to a great extent.

The MNCs and large scale organizations are now aware and are practicing environment friendly practices. This paper tries to find out whether the small and medium scale manufacturers believe and implement them.

Trends of Green Marketing in India

Organizations perceive environmental marketing as an opportunity to achieve its objectives. Firms have realized that consumers prefer products that do not harm the natural environment as also the human health. Firms marketing such green products are preferred over the others not doing so and thus develop a competitive advantage, simultaneously meeting their business objectives. Organizations believe they have a moral obligation to be more socially responsible. This is in keeping with the philosophy of CSR which has been successfully adopted by many business houses to improve their corporate image. Firms in this situation can take two approaches:

- Use the fact that they are environmentally responsible as a marketing tool.
- Become responsible without prompting this fact.

Governmental bodies are forcing firms to become more responsible. In most cases the government forces the firm to adopt policy which protects the interests of the consumers. It does so in following ways:

- Reduce production of harmful goods or by products
- Modify consumer and industry's use and /or consumption of harmful goods; or
- Ensure that all types of consumers have the ability to evaluate the environmental composition of goods.

Competitors' environmental activities pressurize firms to change their environmental marketing activities. In order to get even with competitors claim to being environmentally friendly, firms change over to green marketing. Result is green marketing percolates entire industry.

Cost factors associated with waste disposal or reductions in material usage forces firms to modify their behavior. With cost cutting becoming part of the strategy of the firms it adopts green marketing in relation to these activities. It may pursue these as follows:

- A Firm develops a technology for reducing waste and sells it to other firms.
- A waste recycling or removal industry develops.

Conclusion

Now this is the right time to select "Green Marketing" globally. It will come with drastic change in the world of business if all nations will make strict roles because green marketing is essential to save world from pollution. From the business point of view because a clever marketer is one who not only convinces the consumer, but also involves the consumer in marketing his product. Green marketing should not be considered as just one more approach to marketing, but has to be pursued with much greater vigor, as it has an environmental and social dimension to it. With the threat of global warming looming large, it is extremely important that green marketing becomes the norm rather than an exception or just a fad. Recycling of paper, metals, plastics, etc., in a safe and environmentally harmless manner should become much more systematized and universal. It has to become the general norm to use energy-efficient lamps and other electrical goods.

Marketers also have the responsibility to make the consumers understand the need for and benefits of green products as compared to non-green ones. In green marketing, consumers are willing to pay more to maintain a cleaner and greener environment. Finally, consumers, industrial buyers and suppliers need to pressurize to each other to minimize the negative effects on the environment. Green marketing assumes even more importance and relevance in developing countries like India.

From the above it may be observed that Green marketing is not going to be an easy concept. The firm has to plan and then carry out research to find out how feasible it is going to be. Green marketing has to evolve since it is still at its infancy stage. Adoption of

Green marketing may not be easy in the short run, but in the long run it will definitely have a positive impact on the firm.

Government and Social organizations may compel all the organization to practice Green Marketing for sustainable development. Customers too will be ready to pay premium price for green products. A smart marketer is one who not only convinces the consumer, but also involves him in marketing his product. Green marketing should not be considered as just one more approach to marketing, but has to be pursued with much greater vigor as it has societal and environmental dimensions. Marketers also have the responsibility to make the stakeholders aware about the need and the advantages of green products. The green marketers will have full support of the Government, and the consumers also will not mind paying more for a cleaner and greener environment.

References:

Allaby, M. (1990) "*Green Facts: The Greenhouse Effects & Other Key Issues*", *Reed International Books Ltd.*, London.

Barker A. Tansu (1993) "*A Marketing Oriented Perspective of Standardized Global Marketing*" *Journal of Global Marketing*, Volume 7, Issue Number 2.

Belz F.; K. Peattie (2009) "*Sustainability Marketing: A Global Perspective*", *John Wiley & Sons*, New York.

Carter, Steve (1986) "*Marketing in Less Developed Countries-Time for Dedicated Marketing Systems not Adaptive Transfer?*" *Public Enterprise*, 6, February, pp. 107-120.

Chaudhary, R.; V. Bhattacharya (2006) "*Clean Development Mechanism: Strategy for Sustainability and Economic Growth*", *Indian Journal for Environmental Protection*, Vol. 27(10). Pg 919-922.

Cohen, M. (2001) "*The Emergent Environmental Policy Discourse on Sustainable Consumption, in: M.Cohen and J. Murphy (eds) Exploring Sustainable Consumption: Environmental Policy and the Social Sciences*", pp. 21-37, London: Pergamon.

Cracco, Etienne; Jacques Rostenne (1971) "*The Socio-Ecological Product,*" *MSU Business Topics*, 19 (summer), pp. 28-29.

Dholakia, Nikhilesh (1984) "*Marketing in the Less Developed Countries: Its Nature and Prospects," in G. S. Kindra (ed.), Marketing in Developed Countries, London and Sydney, Croom Helm*, pp. 10-28.

Grundey, D.; R. M. Zaharia (2008) "*Sustainable incentives in marketing and strategic greening: the cases of Lithuania and Romania*", *Baltic Journal on Sustainability*, 14(2), 130 –143.

Grundey, Dainora; Milena Zaharia Rodica (2008) "*Sustainable incentives in Marketing and Strategic Greening: The cases of Lithuania and Romania*", *Technological & Economic Development of Economy*, Vol. 14 Issue 2, p130.

Henion, K. E. (1976) *Ecological Marketing, Grid*, Columbus Ohio.

Henion, K. E.; T. C. Kinnear (1976) "*Ecological Marketing", American Marketing Association*, Chicago, pp. 168

Johri, Lalit M.; Kanokthip Sahasakmontri (1998) "*Green Marketing of cosmetics and toiletries in Thailand, Journal of Consumer Marketing", Journal of Consumer Marketing*, Vol. 15 Iss: 3, pp.265 – 281.

Kingsley, J. (1982) "*The Role of Marketing in Economic Development", European Journal of Marketing*, Vol. 16, No. 6, 64-77.

Kotler, Phillip (1986) "*The Role of Marketing in Development*", *Proceedings of the International Conference on Marketing and Development*, Istanbul, Turkey, September 1-4, 1986.

Kotler, Phillip (1988) "*Marketing Management: Analysis, Planning and Control", Englewood Cliffs*, NJ: Prentice-Hall, pp. 151-152.

Lyytimaki, J.; P. Tapoi (2009) "*Climate change as reported in the press of Finland: From screaming headlines to penetrating background noise", International Journal of Environmental Studies*, Vol. 66(6), Pg 723-735.

Mendleson, N.; J. P. Michael (1995) "*Using strategic alliances to develop credible green marketing*".

Ottman, J. A. (2006) "*Avoiding Green Marketing Myopia*", *Environment,* Vol-48, June-2006.

Pandey, N. G. (2007) "*Environmental Management", Vikas Publishing House Pvt. Ltd.* New Delhi.

Peattie, K.; A. Crane (2005) "*Green Marketing: Legend, Myth, Farce or Prophesy?*", *Qualitative Market Research: An International Journal,* Vol. 8, No. 4, pp. 357-370.

Polonsky, J. M.; T. Alma (Eds) (2008) "*Ecological Imperatives and the Role of Marketing by Sheth, N. Jagdish., Parvatiyar, Atul* ", *Environmental Marketing,* Haworth Press. New York.

Rana, Z. (2010) "*Challenge to Business – Changes in India's Marketing Environment",* *Indian Journal of Marketing,* Vol. 40 (2).

Riley, H. Slater (1983) " *Food Marketing in the economic development of Puerto Rico*" *Research Report No. 4, Latin American Studies Center,* Michigan State University, Michigan.

Shah, P. (2010) "*Awareness & Preference towards Carbon Credits – An Initiative to go for Green", Prabandhan: Indian Journal of Management,* Vol. 3(2).

Sharma, A.; G. Joshi (2006) "*Environmental Issues of India", Indian Journal of Environment Protection,* Vol 26(3). Pg 263-267.

Dutta, B. (2009) "*Sustainable Green Marketing the New Imperative", Marketing Mastermind,* Pg 23-26. Hyderabad: The ICFA University Press.

The Mckinsey and Company Global survey on Knowledge Management (2001) "*Knowledge Unplugged*", *PALGRAVE,* Houndmills, Basingstoke, Hampshire, RG216S, NY.

Uberio, K. N. (2007) "*Environmental management", Excel Books,* New Delhi.

Unruh, G.; R. Ettenson (2010) "*Growing Green; Three smart paths to developing sustainable products", Harvard Business Review,* Vol. 5(6). Boston.

Walker, Rhett H.; J. Hanson Dallas (1998) "*Green Marketing and Green Places: A Taxonomy for the Destination Marketer*", *Journal of Marketing Management,* Volume 14, Issue 6, Pages 623-639, www.epa.qld.gov.au/sustainable_industries.

Section C

Environmental Management in Small and Medium Enterprises

A Research Framework for Environmental Performance Measurement and Management for Indian SMEs

Pradip Kumar Ray*

Abstract

The promotion of SMEs is considered to be of utmost importance in both developed and developing countries as it contributes significantly in the growth of national economy. This article highlights the crucial functions of SME in developing countries as given by the World Bank Report (2002, 2004). But SMEs face certain limitations which pose a major problem for their growth. On the other hand unregulated SMEs also add to the environmental damage in the absence of required infrastructural developments. This article is a research work on the development of an environmental performance measurement and management framework for SMEs in India. Both qualitative and quantitative approaches have been adopted for the research. The adoption of different processes and methods as suggested in this paper by policy makers will ensure a fruitful outcome of this research.

Introduction

In both developing and developed countries, promoting small and medium-sized enterprises (SMEs) is one of the most viable strategies for achieving national development goals, such as economic development, strengthening the industrial base, and local production structure (Hallberg, 2000). SMEs represent a sector of growing importance and play an important role in the growth of emerging nations especially with regards to providing employment and driving economic development (Kula and Tatoglu, 2003).

---

* Professor, Department of Industrial Engineering and Management, Indian Institute of Technology, Kharagpur, India.

Moreover, the small business sector has become more important as they emerge as a dominant force impacting the growth of national economies (Shridhar, 2006).

According to World Bank Report (2002, 2004), there are three crucial functions of SMEs as the engine of growth in developing countries.

First, SMEs enhance competition and entrepreneurship and therefore, have external benefits on economy wise efficiency, innovation and aggregate productivity growth.

Second, SMEs are generally more productive than Large Enterprises (LE's), but the financial market and other institutional failures and non conducive macroeconomic environmental aspects impede SME development.

Third, the expansion of SMEs boosts employment more that LEs' growth because SMEs are more labor-intensive.

In this context, export orientation has a direct impact on SME growth and profitability (Ibesh, 2004; Roper, 1999). Moreover, firms may export to avoid stagnating because of limitations inherent in the local market (Kazem, Heijden, 2006). In India, while small enterprises are clearly defined, there is no clear definition of medium enterprises (FICCI 2002). An SSI unit is broadly defined in terms of value of investment in plant and machinery. At present, a unit which has investment in plant and machinery up to Rs.10 million is defined as an SSI unit (NCAER 2001).

For enterprises engaged in the manufacture of goods, a small scale enterprise is a unit where investment in plant and machinery is over Rs. 2.5 million but not exceeding Rs. 50 million.

For a medium scale enterprise, the investment in plant and machinery is in excess of SSI limit, but less than Rs. 100 million.

For enterprises engaged in providing or rendering of services, the following types of enterprises are defined:

i) Micro: Investment in equipment not exceeding Rs.1 million,

ii) Small: Investment in equipment over Rs.1 million but not exceeding Rs.20 million, and

iii) Medium: Investment in equipment is in excess of SSI limit but less than Rs.50 million.

In the past, SMEs always represented the model of socio-economic policies of Government of India which emphasized judicious use of foreign exchange for import of capital goods and inputs; labor intensive mode of production; employment generation; non-concentration of diffusion of economic power in the hands of few (as in the case of big houses); discouraging monopolistic practices of production and marketing; and finally effective contribution to foreign exchange earning of the nation with low import-intensive operations. It was also coupled with the policy of de-concentration of industrial activities in few geographical centers. By and large, SMEs in India met the expectations of the Government in this respect. SMEs developed in a manner which made it possible for them to achieve the following objectives:

i. High contribution to domestic production
ii. Significant export earnings
iii. Low investment requirements
iv. Operational flexibility
v. Location wise mobility
vi. Low intensive imports
vii. Capacities to develop appropriate indigenous technology
viii. Import substitution
ix. Contribution towards defense production
x. Technology – oriented industries
xi. Competitiveness in domestic and export markets

At the same time one has to understand the limitations of SMEs. Some of the main limitations of SMEs are low capital base, concentration of functions in one or two persons, inadequate exposure to international environment, inability to face impact of WTO regime, inadequate contribution towards R & D, and lack of professionalism.

In spite of these limitations, the SMEs have made significant contribution towards technological development and exports. SMEs have been established in almost all - major sectors in the Indian industry, such as Food Processing, Agricultural Inputs, Chemicals &

Pharmaceuticals, Engineering (Electrical/Electronics),Electro-medical equipment, Textiles and Garments, Leather and leather goods, Meat products, Bio-engineering, Sports goods, Plastics products, and Computer Software, etc. (Table 1).

Table 1: SME Clusters in India

S.No.	Industry Group	NIC Code	No. of Clusters
1	Machinery & Parts except electrical	35	20
2	Cotton Textiles	23	15
3	Chemical & Chemical Products	31	14
4	Metal Products	34	13
5	Hosiery & Garments	26	10
6	Food Products	21-20	9
7	Non-metallic Mineral Products	32	9
8	Electrical Machinery & Parts	36	8
9	Wool, Silk & Synthetic Fibre Textiles	24	8
10	Transport Equipment & Parts	37	7
11	Others 8 Categories	Several	25
	Total		138

It has been estimated that there exist about 350 SME clusters in India. Between 2002 and 2006, production increased by more than 50 percent, exports by about 45 percent; and employment by about 13 percent. The number of registered SMEs grew by about 18 percent, and that of the unregistered by about 12 percent.

Why Research on Impact of Climate Change and Environmental Performance?

Climate change represents one of the most serious environmental challenges faced by humanity today. Its causes and effects, as well as the potential solutions to this challenge, cut across every nation and sector of the economy, ultimately affecting every human being in some way. The Stern Review on the economics of climate change (2006) emphasized that, even under the more moderate scenarios, climate change will have serious impacts on world output, on human life and on the environment. Business and industry, being the largest single contributor to increased Green House Gas (GHG) emissions (Baumert, 2005), could play an important role in stabilization of GHG concentration in the atmosphere. With the growing consensus among scientists regarding the potential impacts of climate change, business and industry are under increasing pressure from investors, governments and environmental organizations to reduce GHG emissions from their processes, products and services. However, this pressure varies from one country to another and across industrial sectors. The focus of many studies, however, has been on the activities of large international corporations, while less is known about the activities of Small and Medium-sized Enterprises (SMEs) located in different countries, especially in emerging economies (e.g. India), and the factors influencing those activities.

Why SMEs?

SMEs are commonly recognized as making large contributions to the global economy and results in many social benefits. SMEs account for more than 85% of the total number of industrial organizations, their domestic industrial production is between 60-70% and they employ large numbers of workers (SMEs employ approximately 4.5 million workers in Vietnam and provide 75% of jobs in China). In particular SMEs in the Asia-Pacific region may be more influential than any other region in the world because of the rapid economic growth of the region today. In India, 50% of the country's total exports are attributed to SMEs, which primarily emerged in natural clusters. A cluster may be defined as a local agglomeration of enterprises that are producing and selling a range of related and complementary products and services. Semi-finished products are sent to other factories in the cluster for the next processing step or the final production. Thus, communication and interaction takes place within the local community throughout the production process, creating trust and solidarity. National governments increasingly promote SMEs' development in recognition of the critical role they play in the socio-economy. They have set policies and supporting measures for the purpose of economic development. Departments/Offices assisting SMEs have been set up in most countries in order to develop a policy framework and implementation plan and to act as a coordinating body for the collaboration with other agencies.

SMEs Impact on Environment

While it is widely accepted that SMEs play a significant role in the economic development they also exert considerable pressure on the environment, not individually, but collectively. SMEs are voracious consumers of resources and energy and the result is a significant generation of waste by-products. Despite this, environmental measures undertaken by SMEs to date have not yielded impressive results, especially when compared to those of large companies. Available research data suggests that SMEs are responsible for more than 50% of the industrial pollution in the Asia-Pacific region and there are numerous examples which suggest that SMEs contribute significantly to environmental damage and GHG emissions. For example, Sri Lanka is the world's second largest producer of black tea. As an SME industry, tea production provides Sri Lankans with 200,000 direct jobs and over one million people are employed indirectly, making it the country's largest employer. However, Sri Lanka consumes 4.45 to 6.84 kWh of energy to produce one kilogram of tea. Also, the industry's CO_2 emissions amount to 2.49 kg of CO_2 per kg of tea produced. This amounts to a total annual CO_2 emission of approximately 700,000 tons.

It is believed that the environmental damage caused by SMEs will grow unless innovative strategies are devised. There are, however, a number of barriers that prevent SMEs from achieving such innovative strategies. These include: a lack of information on the cost-benefits of improving environmental performance, weak external pressure/incentives, lack of internal capacity (e.g. financial resources, human resources, technologies, business processes and R&D activities), weak supporting frameworks and in many cases political indulgence by policy makers.

Environment and climate change issues have attracted significant attention from the corporate world and policy makers around the globe. India is considered to be vulnerable from climate change, but also, given its current economic growth, will increasingly contribute to GHG emissions and so Indian SMEs have a major role to play not only in contributing to the economic development of India but also in helping to combat environmental and climate change issues (Bradford, and Fraser, 2008).

Objectives of the Research Work

The main aim of this research is to develop an environmental performance measurement and management framework for SMEs. The following research questions are relevant:

i. To what extent Indian SMEs are aware of the climate change issues and their implications for the Indian industry?

ii. What is the current state of environmental practices within Indian SMEs?

iii. What institutional framework exists today for environmental performance monitoring of Indian SMEs? Are they conducive for achieving superior performance?

iv. What legislation exists in India related to protection of environment and for the improvement of environment performance of SMEs in India?

v. How could we improve environmental performance of Indian SMEs?

Study Methodology

This study will adopt both qualitative and quantitative approaches along with interview, focus group and case study methods. The methodology to be used consists of a number of steps. These steps are as follows:

i) The proposed research process will commence with an in-depth literature review on climate change issues and environmental practices of SMEs across the world in order to identify issues and challenges they face, policy being adopted, strategies being deployed and framework being used for achieving superior environmental performance.

ii) From this, a questionnaire will be developed to study the environmental practices and performance of Indian SMEs.

iii) The analysis and outcome of the questionnaire survey among 50 SMEs covering manufacturing, process and construction industry will help develop an environmental performance measurement and management framework using an inductive research approach.

iv) This framework will then be applied to six organizations (3 in each country and one each from manufacturing, construction and process industry) in the UK and India to measure their current environmental performance and suggest improvement measures.

v) Additionally, the environmental performance measurement and management framework will then be customized to benchmark Indian SMEs with the UK.

Outcome of the Research

The following outcomes are envisaged and worth mentioning:

i) An innovative environmental performance measurement and management framework for SMEs

ii) The state of environmental practices and performance of Indian SMEs

iii) Improvement measures through benchmarking with the UK-based SMEs

iv) Use of research methods in which we have experience

v) Content analysis method, interview method, multiple attribute decision-making techniques

vi) Researching in Indian/UK companies/cultures

vii) Sustainable research collaboration among participating organizations

In this context, environmental regulations of various types are required to be referred to. A few examples of these regulations are given below:

i. Hazardous Material and Waste Regulation

    - Toxic substance Control Act

  - Federal Insecticide, Fungicide, and Rodenticide Act
  - Hazardous Material Transportation Act
  - Oil Pollution Act
  - Atomic Energy Act
  - Amendment and Reauthorization Act
  - OSHA
  - Uniform Fire code
  - Resource Conservation and Recovery Act

ii. Clean Water Act

iii. Federal Water Pollution Control Act

iv. Oil Pollution Act

v. Safe Drinking Water Act

vi. Clean Air Act

vii. Emergency Planning and Community Right-to-know Act

viii. National Environmental Policy Act

ix. Pollution Prevention Act

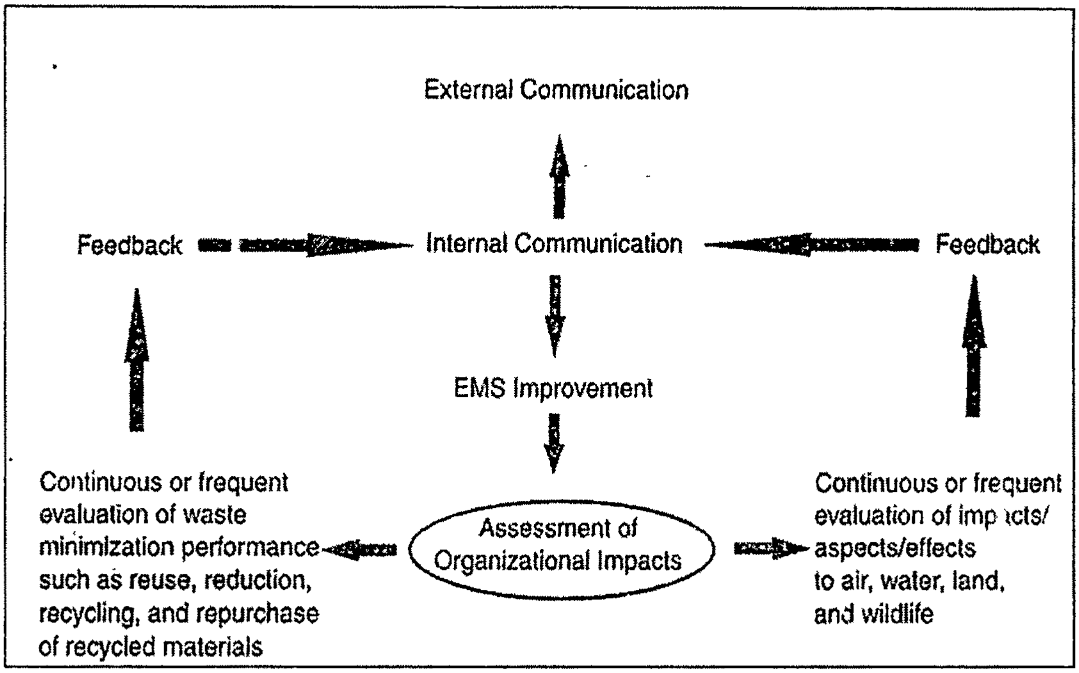
x. Marine Protection Reserve and Sanctuaries Act

xi. Coastal Zone management Act

xii. Endangered Species Act

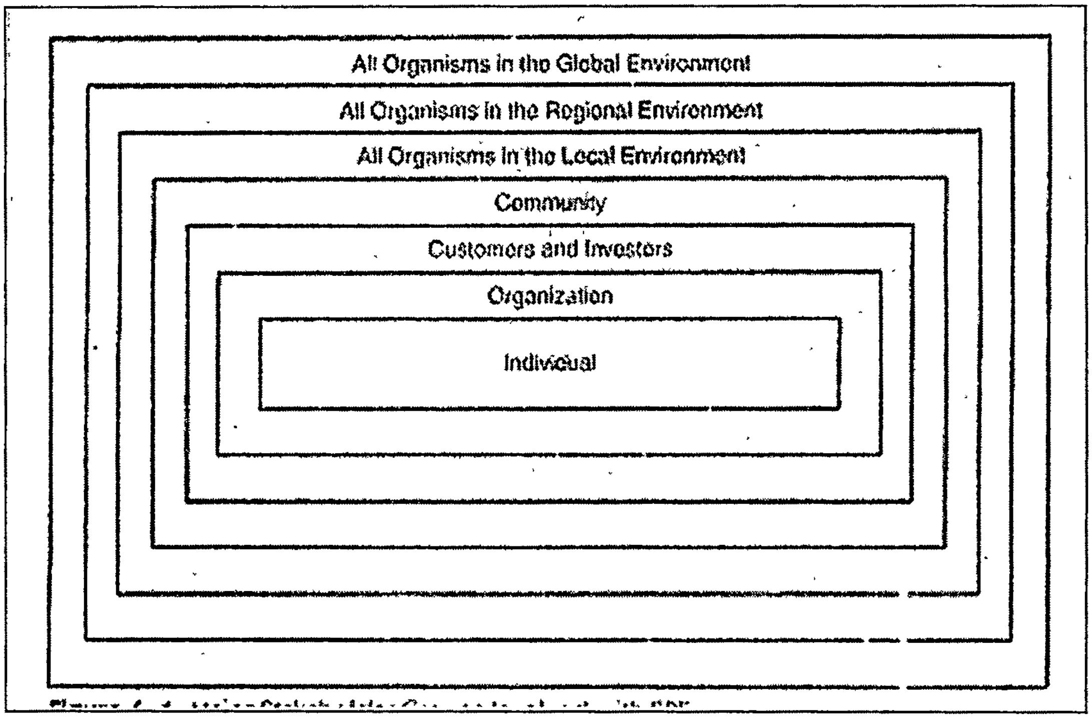
The basic concepts of Environmental Performance Evaluation (EPE) are given in Fig. 1

Fig. 1: Overview of EPE


External Communication
Feedback
Internal Communication
Feedback
EMS Improvement
Continuous or frequent evaluation of waste minimization performance such as reuse, reduction, recycling, and repurchase of recycled materials
Assessment of Organizational Impacts
Continuous or frequent evaluation of impacts/ aspects/effects to air, water, land, and wildlife

EPE is a management tool or process for helping an organization measure and improve environmental performance on an ongoing basis, and EPE is appropriate for all organizations independent of location, size, type and complexity. Selection of meaningful indicators (tools to measure and express the impact of various actions of an organization on the environment) is the critical part of EPE. Indicators are at the heart of the EPE process. Benefits of EPE include environmental improvement, opportunities for prevention of pollution, strategic business opportunities. The stakeholders of EPI are many and varied as shown in Fig. 2.

Fig. 2: Stakeholders Involved with EPE


All Organisms in the Global Environment
All Organisms in the Regional Environment
All Organisms in the Local Environment
Community
Customers and Investors
Organization
Individual

The entire EPI framework is based on a number of premises and assumptions. The main premises are as follows:

i) If the environment is degraded, all living organisms may suffer

ii) Needs of all stakeholders must be considered.

iii) EPE must start on the individual level in terms of assessment and action, and EPE then expands out for the other groups.

iv) If plants and animals (including human) are not considered in EPE, the whole exercise is meaningless

From an organization's perspective, two types of factors, viz. factors internal and factors external to an organization are included in EPE framework. Factors internal to organization are environment, production, legal, human, resources, risk management, and upper management, and the factors external to organization are wildlife, customers, regulators, finance, suppliers, standards, department, consultants, environmental groups, research organizations, politicians, adjoining community, media, and general public.

Project Impact Assessment Method

Such a method consists of a number of steps. These steps are as follows:

Step-1: Preliminary review of existing environment,

Step-2: Selection of environmental indicators,

Step-3: Quantitative description of all existing environmental indicators using available data,

Step-4: Field data collection,

Step-5: Making prediction of the effects on the environment, and

Step-6: Propose modifications that minimize impacts.

Environmental Impact Assessment process

This process addresses a number of issues like:

i. Steps (understand environmental conditions that describe impacts with timing and duration of impacts, measure the impacts, aggregate impacts into an overall assessment, identifying alternatives)

ii. Risk Assessment (Hazard identification, types of studies)

iii. Types of effects to analyze: (i) Dose-response relationship or evaluation, (ii) Exposure assessment, and (iii) Risk characterization,

iv. Modelling (air quality-box model, proportional, Gaussian-based, Numerical-based; water quality, vegetation and wildlife – general environmental/biological, physical, flora, fauna, energy modelling)

v. Lifecycle assessment (from design to disposal)

vi. Use and Disposal of Products

vii. Use by primary consumer

viii. Transportation of product back to manufacturer for repair

ix. Repair

x. Transportation of repaired product back to consumer

xi. Reuse of repaired product

xii. Transport of non-repairable product

xiii. Recycling of the product for raw material values

xiv. Transport of recycled raw materials

xv. Transport of waste materials

xvi. Disposal (Class-I, Class-II and Class-III sites)

The types of indicators are broadly classified under three categories, viz. Management System EMIs, Operational System EMIs, and Environmental EIs. The interrelationships between EMIs are shown in Fig. 3, and the three categories of EMIs are listed in Tables 2(A), (B), and (C).

Fig. 3: Types of Indicators

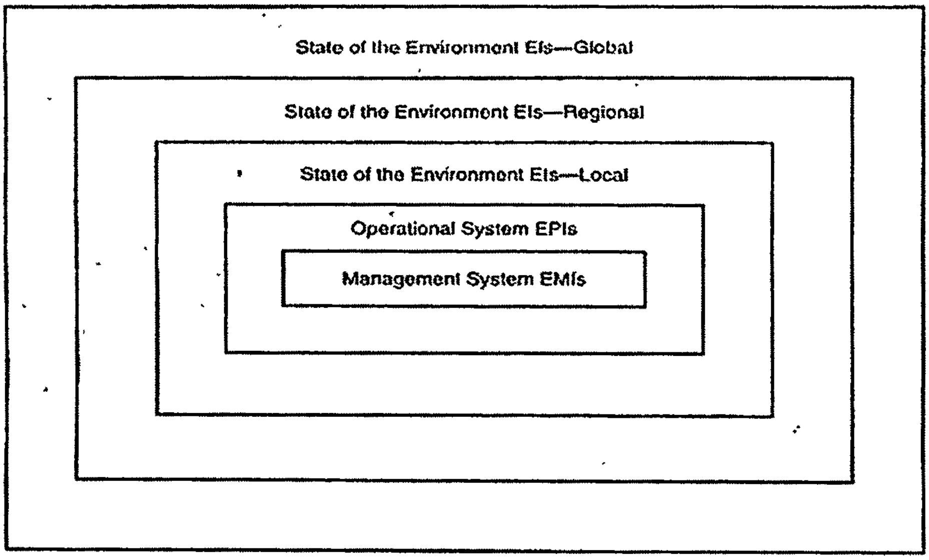
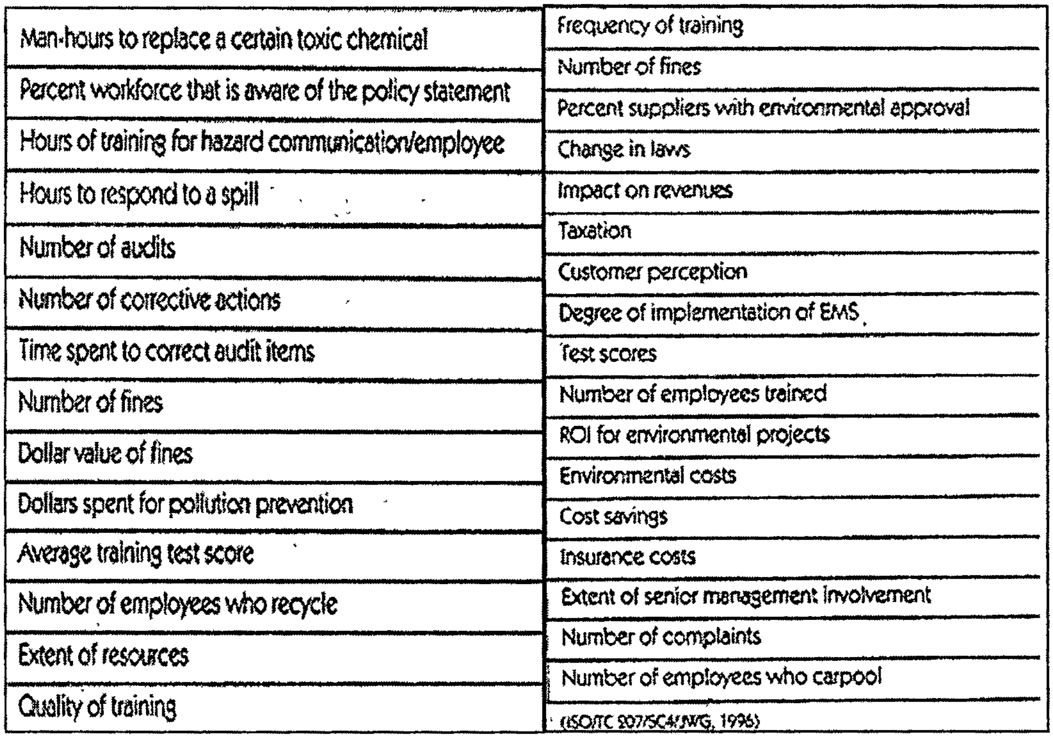

State of the Environment EIs—Global
State of the Environment EIs—Regional
State of the Environment EIs—Local
Operational System EPIs
Management System EMIs

Table 2 (A): Management System EMIs

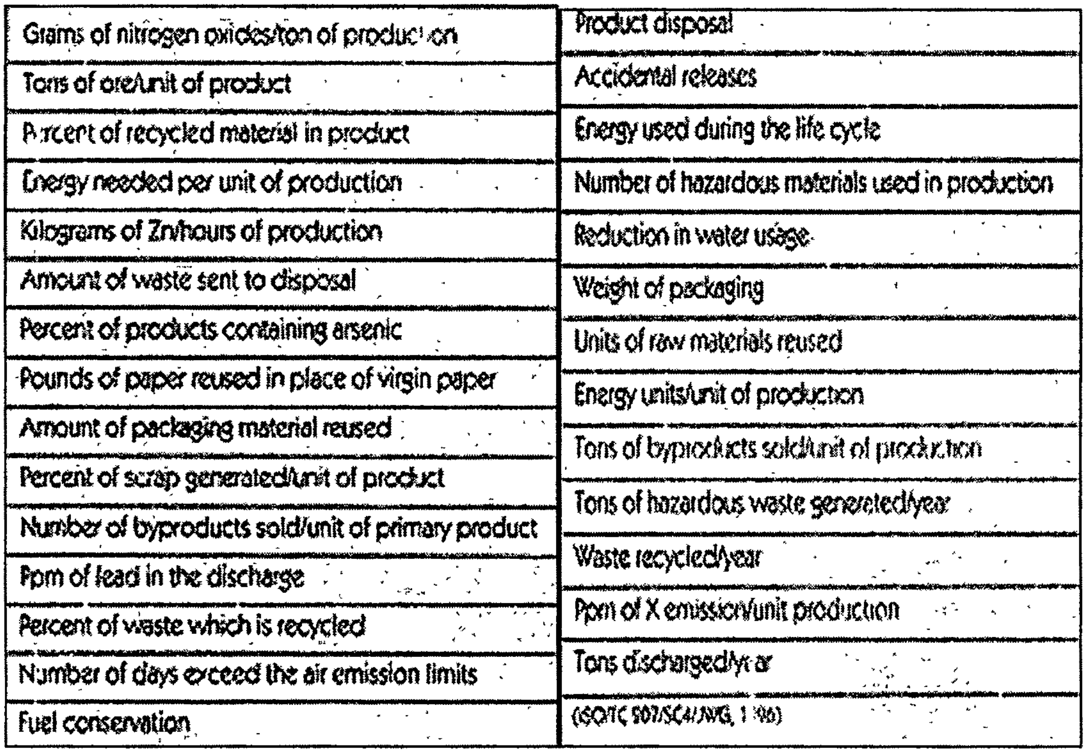


- Man-hours to replace a certain toxic chemical
- Percent workforce that is aware of the policy statement
- Hours of training for hazard communication/employee
- Hours to respond to a spill
- Number of audits
- Number of corrective actions
- Time spent to correct audit items
- Number of fines
- Dollar value of fines
- Dollars spent for pollution prevention
- Average training test score
- Number of employees who recycle
- Extent of resources
- Quality of training

- Frequency of training
- Number of fines
- Percent suppliers with environmental approval
- Change in laws
- Impact on revenues
- Taxation
- Customer perception
- Degree of implementation of EMS
- Test scores
- Number of employees trained
- ROI for environmental projects
- Environmental costs
- Cost savings
- Insurance costs
- Extent of senior management involvement
- Number of complaints
- Number of employees who carpool

(ISO/TC 207/SC4/WG, 1996)

Table 2 (B): Operational System EPIs



- Grams of nitrogen oxides/ton of production
- Tons of ore/unit of product
- Percent of recycled material in product
- Energy needed per unit of production
- Kilograms of Zn/hours of production
- Amount of waste sent to disposal
- Percent of products containing arsenic
- Pounds of paper reused in place of virgin paper
- Amount of packaging material reused
- Percent of scrap generated/unit of product
- Number of byproducts sold/unit of primary product
- Ppm of lead in the discharge
- Percent of waste which is recycled
- Number of days exceed the air emission limits
- Fuel conservation
- Product disposal
- Accidental releases
- Energy used during the life cycle
- Number of hazardous materials used in production
- Reduction in water usage
- Weight of packaging
- Units of raw materials reused
- Energy units/unit of production
- Tons of byproducts sold/unit of production
- Tons of hazardous waste generated/year
- Waste recycled/year
- Ppm of X emission/unit production
- Tons discharged/year

(ISO/TC 207/SC4/WG, 1996)

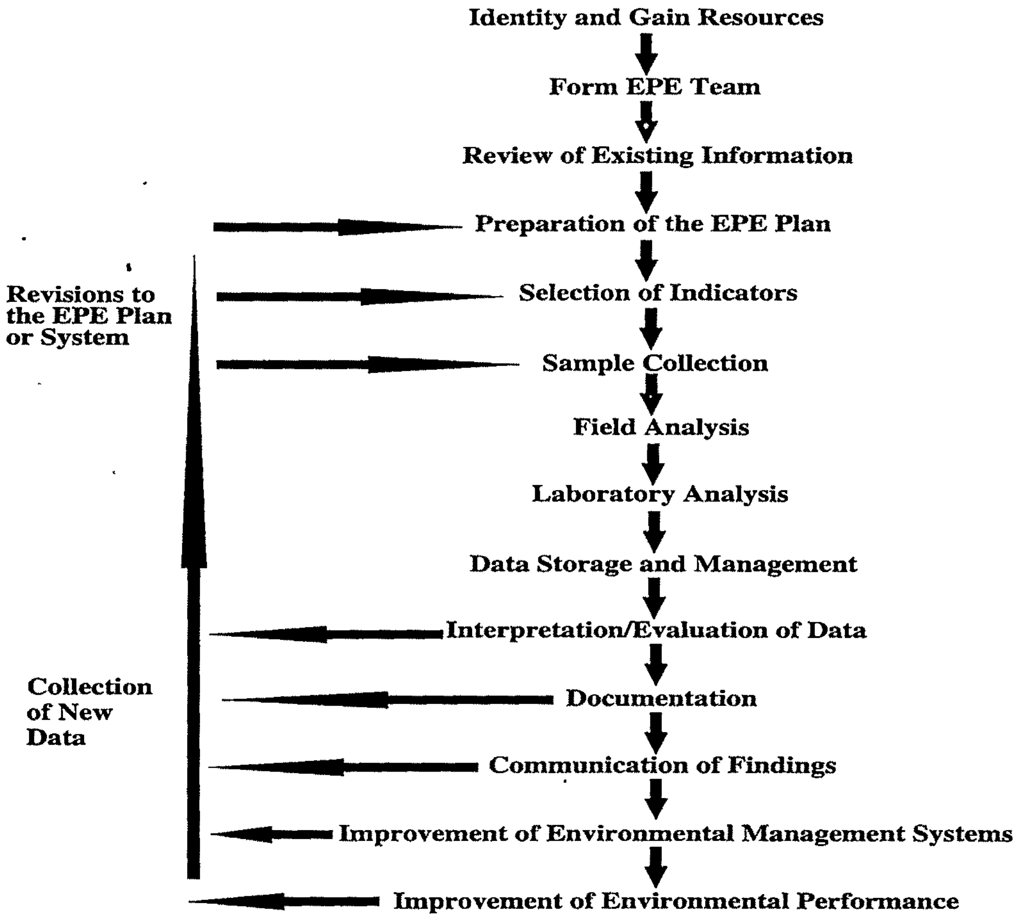
Table 2 (C): Environment EIs

Acres of wetlands removed
Ppm of Hg in the soil
Number of Species present/acre
Degree of bioaccumulation in a species
Blood lead level
Reduced crop yield
Increased algae bloom
Fish death
ncreased frequency of skin cancer
Higher global temperature
Air quality impacts
Climate charge
Loss of species

Reduction in visibility
Impact on nonrenewable resources
Greenhouse gases
Habitat depletion
Smog formation
Number of fish species
Release of heavy metals to soil
Amount of mineral extracion
Number of new skin cancer cases
Mm of sea level rise
Degree of global temperature rise
(ISO/TC 207/SC 4/JWG, 1996)

The overall EPI process is shown in Fig. 4

Fig. 4: Overall EPE Procedure/Process


Identity and Gain Resources
Form EPE Team
Review of Existing Information
Preparation of the EPE Plan
Revisions to the EPE Plan or System
Selection of Indicators
Sample Collection
Field Analysis
Laboratory Analysis
Data Storage and Management
Interpretation/Evaluation of Data
Collection of New Data
Documentation
Communication of Findings
Improvement of Environmental Management Systems
Improvement of Environmental Performance

References:

Baumert, Kevin A.; Harald Winkler "*Sustainable Development policies and measures and International Climate Agreements*".

FICCI (Federation of Indian Chambers of Commerce and Industry) (2002) *SMEs and Globalization*. Report of the Global Summit - Business Partnership Meet - 2002. New Delhi, FICCI.

Hallberg, Kristin (2000) "*A market oriented strategy for small and medium scale enterprises*," IFC discussion paper 40, The World Bank and International Finance Corporation, Washington D.C., USA.

Ibeh, K., (2004) "*Furthering export participation in less performing developing countries*". *International Journal of Social Economics,* Vol.31, Nos.1/2, pp. 94-110.

Kazem, A.; B. Heijden (2006) *"Exporting Firms' Strategic Choices: The Case of Egyptian SMEs in the Food Industries," S.A.M.* Advanced Management Journal, 71(3), 21-33.

Kula, Veysel; Ekrem Tatoglu (2003) "*An exploratory study of Internet adoption by SMEs in an emerging market economy*", European Business Review, Vol. 15 Iss: 5, pp.324 – 333.

National Council of Applied Economic Research Report on SMEs (2001). NCAER (National Council of Applied Economic Research). *An Assessment of Small-Scale Informal Forestry Sector*. Report prepared under the p*roject "Instruments for Sustainable Private Sector Forestry"* coordinated by International Institute for Environment and Development and Ecotech Services and supported by DFID-India. New Delhi: NCAER.

Roper, S. (1999) "*Modeling Small business growth and profitability*", *Small Business Economics*, Vol. 13, pp. 235-252.

Shridhar, M. (2006) "*Incubators and science parks: strategies for developing countries*". www. anprotec.org.br/idisc/pdfs/publiacoes/155.doc (accessed 2 July), pp. 1-20.

World Bank (2002) *"SME," World Bank Group Review of Small Business Activities*, Washington, DC: World Bank.

World Bank (2004) "SME," *World Bank Group Review of Small Business Activities*, Washington, DC: World Bank.

Micro, Small and Medium Enterprises and Environmental Sustainability Issues and Challenges in India

Nikhil Bhusan Dey*

Abstract

This article mainly focuses on impact on the environmental sustainability as a fall out of Micro, Small and Medium Enterprises (MSMEs) in India. The author discusses the continuous degradation of ecological assets due to industrial pollution as well as the relevant Environmental Legislation of India and other environmental protection methodologies like CSR, ESR, etc. which have been adopted to preserve the social and environmental balance. In the latter half of the paper the industrial pollution caused by MSMEs and the major environmental issues and challenges have been addressed. The author has also mentioned how the pollution so generated can be controlled if proper initiative is taken. However, more awareness, concerted efforts at all levels from private to government organizations and introduction of modern technologically advanced interventions will ensure reduction of pollution by MSMEs.

Introduction

Our environment is continuously interacting between its two components i.e., the living or biotic components and the non-living or abiotic components. Economic development is intricately linked to environment. During the last few decades, there has been tremendous economic growth and development. At the same time there have been social and ecological disruptions both in developed as well as in developing countries. Rapid industrialization besides other economic and social factors is causing great harm to our environment. The concern for deteriorating environment is, however, reflected in the policies of Government of various countries and besides the Government a large number of Non-Governmental Organizations (NGOs) are involved in the process of environmental protection at global,

---

*Professor, Department of Commerce, School of Management Studies, Assam University, India.

national, regional and local levels. As many as 20,000 or more environmental NGOs in Europe and North America and some 5000 odd in India with quite a large number having popular support and considerable influences on the Governments of those areas are engaged in environmental protection. We are passing through a crucial transition period from the era of environmental neglect to the era of environmental concern. "The climatic uncertainties in sub-Saharan Africa are not unrelated to environmental neglect, and the time has certainly come to reverse that negligence. Environmental changes takes time, but co-ordinated public efforts in this field can make a difference in the long run" (Sen, 1998).

Sustainable Development

The global concern for the steadily deteriorating state of the environment was first seriously manifested in the United Nations Conference on Human Environment, which was held at Stockholm in June 1972. It focused attention on the dangers posed to the quality of human life by continuous degradation of ecological assets and pollution due to industrial effluents (Bhattacharjee, 1996). This conference led to the establishment of United Nations Environmental Programme (UNEP) and the creation of World Commission on Environment and Development in 1983 headed by Madam Brundtland, the then Prime Minister of Norway.

Economic development without environmental considerations can cause serious environmental damage in turn impairing the quality of life of present and future generations. The old concept of natural resources as plenty and abundantly available as free gift of nature, is no longer valid. Natural resources are not fixed assets. Natural resources are again not unlimited and proper steps must be taken for their replenishment. Moreover, global economic growth has brought a host of undesirable effects like Ozone depletion, global warming, water and soil contamination, air pollution, and deforestation and wastes disposal. The term sustainable development was brought to use by Brundtland Commission in 1987 which indicate "meeting the needs of the present generation without compromising the needs of future generations. The Earth Summit held at Rio de Janerio (Brazil) in June 1992 organized by the United Nations Conference on Environment and Development adopted a comprehensive 500 page agenda for the 21st century popularly known as '*Agenda 21*'. *Agenda 21* contains a separate chapter devoted to business and industry.

Amongst the major environmental problems, global warming, climate change, soil erosion, land degradation, deforestation, over exploitation, loss of biodiversity, atmosphere pollution, water pollution, problem of solid waste management, coastal and marine pollution are more important. In most of the above cases industrial and business activities are directly responsible for environmental problems. Poverty and population are also responsible for environmental degradation. Business and industries being a part of the society and also directly or indirectly contributing towards environmental degradation cannot remain a silent spectator in such a situation.

Environmental Legislation in India

The growing concern for environment protection is also reflected in the governmental policy of India. The 42nd amendment to the Indian Constitution in 1976, Article 48A was added to the Directive Principles of State Policy and stated that "The State shall endeavor to protect and improve the environment and to safeguard the forests and wild-life of the country". In the chapter of Fundamental Rights, Article 58(A) provides that "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures". Moreover, the entries dealing with forests and wildlife were shifted from the State list to concurrent list. Several pieces of legislation concerning environment were enacted before and after the aforesaid amendment to the constitution. The Major Acts in this regards are:

1. The Factories Act, 1948.
2. The Insecticides Act, 1968.
3. The Wildlife (Protection) Act, 1972 as amended upto date.
4. The Water (Prevention and Control of Pollution) Act, 1974 as amended in 1988.
5. The Forest (Conservation) Act, 1980.
6. The Motor Vehicles Act, 1939 as amended in 1988.
7. The Public Liability Insurance Act, 1991.
8. The Hazardous Waste (Management and Handling) Rules, 1989.
9. The Air (Prevention and Control of Pollution) Act, 1981.
10. The Environment (Protection) Act, 1986.

Attempts are also being made to amend the Indian Companies Act, 1956 to incorporate a statement on Environment to be prepared and included in the Annual Report of the Companies.

The Government of India's concern for environment is also manifested in recent years in various forums and documents. As per Human Development Index (2011) India's position is 134th out of 187 countries. The Economic Survey 1998-99 has outlined sustainable development as a major economic issue of the environmental policy of the Government of India. The document under the caption "Promoting Sustainable Development, Challenges for Environment Policy" contained 15 specific policy issues on environmental aspects.

Corporate Social Responsibility

Corporate social responsibility (CSR) is considered now a days as a very important function of every company. Corporate environment management is a part of CSR. Much discussion and writings are available on CSR but it cannot be denied that all enterprises, big or small, should perform social responsibility. Hence Enterprise Social Responsibility should be considered as a function of all enterprises including small enterprises. Similarly from corporate environment management our attention should be on enterprise environment management embracing micro, small, medium and large enterprises. All enterprises irrespective of their size and nature should contribute towards society by performing its responsibilities towards society.

Corporate Environment Management

Realizing the importance of the sustainable development and management as a long term of global strategy, the corporate houses are expressing their concern in environment management in the organization. A new area has thus emerged in management popularly known as Corporate Environment Management. The scope of the corporate environment management is:

1. Environmental Impact Assessment
2. Environmental Risk Management
3. Environmental Accounting
4. Compliance of Environmental Legislation
5. Environmental Auditing and
6. Environmental Reporting.

Enterprise Social Responsibilities (ESR) for MSMEs

All the above scope of corporate environment management are equally applicable for MSMEs whether they are company or not. More specifically the following are some of the important areas of social and environmental responsibilities for MSMEs:

Meeting legal requirements.
Good management practices.
Capacity building and skill development of workers and employees.
Health and safety of workers.
Local area management like keeping surroundings clean, ISO compliance, etc.
Combat global warming by using clean technologies,

Conservation of energy and

Proper wastes management.

Contribution of MSMEs to Indian Economy

The industrialisation process in the country is picking up and today India has wide industrial base and almost all types of manufacturing industries are existing or being set up. The pace of industrialisation has been accelerated with the recent liberalisation programmes in the country and has been stimulated by the entry of well known multinationals and foreign capital. The controls are gradually being relaxed with continuous reforms in duties, taxes. and administrative structure. However, the development of infrastructure has not picked up with the same pace as industrialization and is proving to be a bottle-neck. It is necessary that industries should also comply with environmental norms. Industrial development without environmental consideration can be disastrous in the long run,

Micro, small and medium enterprises have been playing a very crucial role towards contribution to the national economy. The most important arguments for MSME are employment generation, low capital investment per employee and balanced regional development. The relative contribution and importance of MSMEs deserves special attention in various issues including environmental issues. Pollution of air, water, land etc. is a major issue for industries which needs to be addressed with lot of seriousness. The Micro, Small and Medium Development Act 2006 defines and classifies such enterprise into two distinct types, namely manufacturing and service enterprises. As per the definition the micro, small and medium enterprises are classified as follows:

Table 1: Definition of Micro, Small and Medium Enterprises as per MSMED Act, 2006

	Manufacturing enterprises	**Service enterprises**
	Investment in Plant and Machinery	Investment in equipments
Micro	Upto 25 lakh	Upto 10 lakh
Small	Above 25 lakh but not exceeding 5 crore	Above 10 lakh but not exceeding 2 crore
Medium	Above 5 crore but not exceeding 10 crore	Above 2 crore but not exceeding 5 crore

MSMEs not only play crucial role in providing large employment at comparatively lower capital cost than large industries but also help in industrialization of rural and backward areas, thereby, reducing regional imbalances, assuring more equitable distribution of national income and wealth.

MSMEs are complementary to large industries as ancillary units and this sector contributes enormously to the socio-economic development of the country.

The overall performance of MSMEs in during the period 2000-01 to 2009-10 is presented in the following table.

Table 2: Performance of MSME sector in India during 2000-01 to 2009-10

Year	Total MSMEs (Nos. in lakh)	Fixed Investment (Rs. Crore)	Production (Rs. Crore) at Current Prices	Employment India (Lakh persons)	Export (Rs. Crore)
2000-01	101.01	146845	261297	238.73	69797
2001-02	105.21	154349	282270	249.33	71244
2002-03	109.49	162317	314850	260.21	86013
2003-04	113.95	170219	364547	271.42	97644
2004-05	118.59	178699	429796	282.57	124417
2005-06	123.42	188113	497842	294.91	150242
2006-07	261.01	500758	709398	594.61	182538
2007-08	272.79	558190	790768	626.34	202017
2008-09	285.16	621753	880805	659.35	NA
2009-10	298.08	693835	982919	695.38	NA

Source: Annual Report of Ministry of MSME for the year 2010-11.

Currently, MSMEs share in national GDP is about 17% and is projected to touch 22% by end of 2012. This is due to the fact that over 55% of MSMEs are aggressively upgrading themselves technologically to reduce their input costs and increase production and exports. MSMEs had been growing at the rate of 35% over the last 2 years and now onwards are expected to register 40% growth rate which will be technology driven and contribute 46% share to the country's manufacturing output.

MSMEs share of national exports currently is estimated around 38% which is expected to surge to 44% in next 5 years. Currently, this sector accounts for 95% of industrial units and contributes about 40% in terms of value addition in the manufacturing sector. More than

30 million MSMEs are spread over the country producing about 7,500 items and providing employment to more than 70 million persons. According to 4th All India census of MSMEs (2006-07) 94% of the units are unregistered, 95 % are proprietary and 29% are manufacturing and 95% are micro.

Important Features of MSMEs

-family managed enterprises
- loose management structure
- use of conventional and old technology
- lack of highly specialized technical skills and professional management
- they don't try to grow in size due to fiscal incentives available for being small
- lack of financial resources in general
- lack of R & D activities and little emphasis on training of employees

MSMEs and Environmental Management

The present paper highlights the issues and challenges of environmental sustainability for micro, small and medium enterprises in India. The environment management issues are new for MSMEs because MSMEs are mainly concerned with production function followed by finance and marketing. The efficient management of human resources and environment is considered as something less or not required by the management as a function to be performed. From academic point of view also the major areas of studies and research in MSMEs include:

- Entrepreneurship development.
- Financial problems.
- Marketing problems
- Human Resource Management problems.
- Growth and development of SSI sector etc.

Very limited research has been undertaken on environmental issues of MSMEs and research on this aspect is essential in the present context of economic development and related environmental problems.

Environmental Issues in MSMEs

Environmental Pollution: As we know business and industry is the biggest polluter and the ugly face of environment is reflected in the industrial pollution. It is also true that besides the industrial pollution like water pollution, air pollution, noise pollution, land pollution; deforestation, uncontrolled use of natural recourses as raw materials, discharge of chemical and others waste materials, solid waste management by urban bodies need urgent and immediate attention. Industries are classified as per the guideline of the CPCB (Central Pollution Control Board) as red (highly polluting), orange (moderately polluting) and green (low polluting). The various issues concerning pollution can be identified as:

(a) Location
(b) Governmental policy
(c) Uses of raw material
(d) Discharge of liquid effluent
(e) Management of noise
(f) Health of worker
(g) Safety and accidents of workers
(h) Staff welfare

An estimated 70 percent of the total industrial pollution load is attributed to the Small and Medium enterprises (SMEs) many of which, particularly the small-scale units, continue to use obsolete technologies with no or primitive pollution control methods. This is an issue which has been of concern to the industry associations also. CII, Natural Capital Conservation & Development (NCCD) Council in its key issues calls for developing ways in which SMEs could be assisted to implement sustainability practices. A study of the environmental performance of Indian SMEs would reveal that a progressive framework or roadmap of environmental performance does not exist. There is a requirement to put in place a system, with suitable training assistance and financial aid and incentive at each stage to derive a progressive and enhanced environmental performance from the SMEs. The existing assistance and financial schemes are to an extent piecemeal and uncoordinated and are required to be integrated into a well thought out frame work.

MSMEs not only play crucial role in providing large employment opportunities at comparatively lower capital cost than large industries but also help in industrialization of rural and backward areas, thereby, reducing regional imbalances, assuring more equitable distribution of national income and wealth. MSMEs are complementary to large industries as ancillary units and this sector contributes enormously to the socio-economic development of the country. For example Coir Industry is an agro-based traditional industry, which originated in the state of Kerala and proliferated to the other coconut producing states like Tamil Nadu, Karnataka, Andhra Pradesh, Orissa, West Bengal, Maharashtra, Assam, Tripura, etc. The acceptability of Coir products has increased rapidly due to its 'environment friendly' image. However, the environmental issues are mostly sidelined and are soft victim because of prominence of other issues towards human resource development in MSMEs. For example, during 2006-07, out of a total 75 training programmes conducted by Guwahati MSME-DI having a jurisdiction of Assam, Meghalaya and Arunachal Pradesh, with six branches covering 43 districts only 1(one) program was for energy conservation providing training to 22 persons out of total 3390 persons trained during that period. The situation is depicted in Table 3.

Table 3: Annual Performance of MSME-DI, GUWAHATI from April 2006 to March 2007

Sl. No.	Names of training programmes	No. of programmes conducted	No. of persons trained
1.	Entrepreneurship Development Programme (EDP)	24	777
2.	Management Development Programme (MDP)	16	410
3.	Motivational campaigns	27	2052
4.	Skill Development Programmes	4	54
5.	Vendor Development Programme	2	45
6.	Energy Conservation Programmes	1	22
7.	Intellectual Property Rights	1	30
8.	Project Profiles Prepared	26 No.s	
9.	State Industrial Profile	3 No.s	
10.	District Industrial Potential Survey Reports	2 No.s	
11.	Total Revenue Earnings of the Institute	Rs. 6,97,993 /-	

Source: MSME-DI Guwahati website

Table 4: Human Resource and Industrial Pollution

SHARE OF DIFFERENT INDUSTRIES IN VALUE ADDED, OUTPUT AND EMPLOYMENT, IN PER CENT									
	No. of Persons Engaged			**Value of Output**			**Value Added**		
	1990-91	2002-03	2005-06	1990-91	2002-03	2005-06	1990-91	2002-03	2005-06
More Polluting Industries*	30.43	39.48	38.64	52.09	56.49	59.64	54.34	62.65	64.55
Somewhat Polluting Industries#	67.34	57.63	57.93	46.62	40.73	36.65	44.17	34.90	32.71
Less Polluting Industries	2.22	2.88	3.44	1.30	2.77	3.71	1.49	2.45	2.74
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: ASI - Summary Results for factory sector, CSO, Dept. of Statistics, Ministry of Planning and Program Implementation, Govt. of India, New Delhi.

Industrial Pollution

The most important causes of Industrial Pollution in MSMEs:

a) Prevalence of outdated-inefficient technologies that generate a large amount of waste.

b) Large unplanned industrial conglomeration that have encroached upon and severely polluted their environs.

c) The existence of large number of micro small and medium enterprises that escape land use and some time even environmental regulations.

d) Poor enforcement of Pollution control laws and

e) Lack of resources for implementing Pollution Control programmes.

The ISO 14000 series is a complete package of Environment management system in organizations. MSMEs in India can take the initiatives to implement ISO 14000 in a phased manner starting from highly polluting to less polluting industries.

The ISO 14000 series consists of the following documents concerning environment management:

- 14001 : Environmental Management System Specification
- 14004 : General Guidelines on Systems, Principles and Supporting Techniques.
- 14010 : General Principles on Environmental Auditing.
- 14011 : Auditing of Environmental Management Systems.
- 14012 : Qualification Criteria for Environmental Auditors.
- 14013 : Management of Environmental Audit Programs.
- 14014 : Initial Reviews.
- 14015 : Environmental Site Assessments.
- 14021 : Environmental Labeling Series.
- 14031 : Evaluation of Environmental Performance.
- 14041 : Life Cycle Assessment Series.
- 14050 : Terms and Definitions.
- 14060 : Guide for the inclusion of Environmental Aspects in Product Standards

Suitable training assistance and financial aid and incentive at each stage to derive a progressive and enhanced environmental performance from them MSMEs are needed.

The major environmental issues and challenges in MSMEs are the following:

1. Obsolete technologies.
2. Industrial waste (depletion of natural recourses and contributing to pollution).
3. Health hazard of employees (impure drinking water).
4. Poor working conditions (lack of proper sanitation).
5. Low wages (lower standard of living).
6. Poor compliance (poor compliance of environmental laws).
7. Handling of hazardous materials by workers.
8. Lack of education of employees contributing towards risk of life hazardous works.

Interestingly India has highest Clean Development Mechanism (CDM) projects in the world but uses only 5% of them.

Establishment of compliance assistance centre for MSMEs in MSME Development Institutes to create awareness on better environment management practices, policies and procedures as well as for better compliance of environment regulations from the Ministry is needed.

Development of Environment Friendly Technologies and Strengthening of Pollution Control Boards for monitoring industrial pollution and technologies which will not be creating any environmental problems is also needed to be undertaken on priority basis.

ECOMARK certification is a measure which if made compulsory for polluting industries and then for less polluting industries phase wise will go a long way in environmental compliance. Environmental reporting mechanism should be developed for Indian MSMEs sector and should be made mandatory as a part of Enterprise Social Reporting.

Rainwater harvesting should be encouraged in the MSME units.

ISO 9000/14000 certification should insist for governmental assistance.

Use of non-conventional energy for running low power equipments may be encouraged by providing incentives to MSMEs.

Self-monitoring and Reporting

According to the national Environmental (Protection) Rules of 1986, each polluting industry must submit an Environmental Statement at the end of each financial year (April to March). The Environmental Statement should include the following information:

- Water and raw material consumption;
- Air and water pollution discharged by parameter (average daily quantity and concentration as well as percentage of variation from the prescribed limits);
- Hazardous waste generation (total quantity from the production process and pollution control installation Information Disclosures) and methods of disposal;
- Solid waste generation, reuse, recycling, and disposal; and
- Pollution abatement measures implemented.

Some of the Initiatives of SIDBI towards Environment Protection by MSMEs

Electronic Waste recycling in Bangalore – SIDBI assisted E-Parisara Pvt. Ltd., Bangalore for electronic waste recycling project. The project caters to wastes generated by IT, Telecom & Electronic industries in and around Bangalore. The advantages accruing from the project includes helping more than 100 MSMEs to become compliant with regulatory requirements / environment audit, reduction in waste treatment cost and reuse & recycling of treated metals / materials.

Common Effluent Treatment Plant (CETP) MSME textile dyeing & printing units in and around Surat – Gujarat Environ Protection & Infrastructure Ltd. has been assisted to set up Treatment Storage and Disposal Facilities (TSDF) in Surat to help MSME textile dyeing and printing units in proper waste disposal. Majority of 300 MSMEs member units have been able to become compliant with pollution control norms.

CETP, Bangalore- Eco Green Solution Systems (P) Ltd. has been assisted for setting up of a Treatment Storage and Disposal Facilities (TSDF) facility for toxic waste generated from the electroplating, powder coating, and metal finishing industries in and around Bangalore. It has helped more than 300 MSMEs in reuse and recycling of treated effluent, reduction in waste treatment cost per unit etc.

Mumbai Taxi Financing Scheme – SIDBI has entered into arrangements with Mumbai Taximen's Association / Union and Maruti Suzuki Ltd. for providing assistance to taxi drivers (micro entrepreneurs) to phase out their old taxis. Under the Scheme, taxi drivers have been provided assistance to buy new taxis without any collateral security under CGTMSE coverage. More than 700 Micro entrepreneurs have so far been provided finance under this arrangement. The initiative has helped in promoting clean technology thus controlling pollution.

Solar Lanterns – Friends of Women's World Banking (FWWB), a MFI was sanctioned assistance of Rs.10 crore for providing assistance to micro entrepreneurs for acquiring Solar Lanterns of 2 watts each. 50, 000 micro entrepreneurs are proposed to be covered under the assistance.

Information dissemination – SIDBI has organized several awareness campaigns for propagating JICA supported scheme for achieving Energy Efficiency in high energy intensive MSME clusters to create awareness about environment friendly and energy efficient technologies suitable for the respective clusters. In such seminars, MSMEs were given information on green technologies, better production processes, investment required and cost benefit analysis of each investment.

Credit facility (CF) has been channelized to over 2050 MSMEs – The Project has adopted international best practice of Environment and Social Risk Assessment framework (E&S) in its appraisal process. More than 100 credit officials have been trained on E&S. Instilling Energy Efficiency (EE) in these adopted clusters has emerged as one of the cross cutting issues.

SIDBI and Bureau for Energy Efficiency (BEE) – Memorandum of Understanding (MoU) with the Bureau for Energy Efficiency (BEE) for creation of a shelf of energy efficient technologies for 25 MSME clusters.

Preparation of Carbon Credit Guidebook for MSMEs, update its existing basket of 800 technologies and flag them as carbon free, clean, energy efficient technologies.

SIDBI in association with DSIR, Ministry of Science and Technology, is evolving policy document on ' Technology Vision for Indian MSMEs – 2020'.

It is expected to be a tool, providing boost to innovative traits of Indian MSMEs.

Green Ratings - With support under MSMEFDP, SME Rating Agency (SMERA) – an associate of SIDBI, is gradually introducing rating variants and the latest is "Green Rating" model.

Gujarat Pollution Control Board has taken some initiatives for MSMEs like:

1. Cleaner Production promotion and propagation in the state – CETPs for treatment of liquid effluents etc.
2. Plantation of trees and other environment protection initiatives.
3. Periodic monitoring of water and air quality at various locations.
4. Collection, treatment and disposal facilities for effluents generated from industries as well as common TSDFs for disposal of solid and hazardous wastes.
5. Government will encourage industries to use cleaner technologies.
6. Private accredited consulting agencies to assess the industries.

7. Gold Pass System - Gujarat Pollution Control Board has introduced a system of Gold Pass for the existing units having followed the pollution norms satisfactorily in the past, for expeditious processing of their future applications.

Govt. of Gujarat provides assistance to encourage Green practices and Environmental audit to MSMEs for:

a) Use of clean efficient and innovative pollution control equipments.

b) Periodic environmental audits.

c) Encouraging EMS.

d) Purchase of equipments for safety, occupational health for a cluster of industries (minimum 10).

e) Installation of solar system.

It is also proposed that a coordinating nodal agency be created by the Gujarat Government to help trading of the carbon credit announced under the Kyoto Protocol for the benefit of industries of Gujarat. The initiative will bring International funding for local entrepreneurs.

Conclusion

With increased level of awareness about environment protection the most important issue before Indian Micro, Small and Medium Enterprises in the coming years will be environment management. Concerted efforts at all levels are needed with all seriousness to translate the idea of Enterprise Social Responsibility by Indian MSMEs into reality. MSMEs in India, being a very important stakeholder of the society, must come forward with a positive attitude towards environmental issues and introduce all modern and safe technologies which will ensure reduction of pollution level and also safeguard the health aspect of the large workforce of the MSMEs.

References:

Banerjee, B (2009) *Corporate Environmental management*, A *study with reference to India*, PHI.

Bhattacharjee, J. B. in *Our Environment*, AU, Silchar (1996) (Authored by Gupta, A.; M. Dey and P. R. Bhattacharjee).

Charumathi,B. (1998) *Added accountability of the corporate sector for Environmental concern. Journal of Accounting and Finance*, Vol 12 (2).

Dey, N.B. (2002) *Environmental Auditing for Effective Corporate Management* published in *Environmental Accounting and Reporting.* (Ed: A.K. Pramanik) Deep and Deep Publications Pvt. Ltd. New Delhi.

GOI, Ministry of MSMEs (2012) *Report of the Working Group on Micro, Small and Medium Enterprises (MSMEs) Growth for 12th Five Year Plan* (2012-2017).

GOI, Ministry of MSMEs (2009) *Quick Results of Fourth All India Census of MSMEs*, 2006-2007.

Gulati, M. *Improving environmental compliance through mandatory disclosure - a home grown model for Indian SMEs,* www.ecoinsee.org

http://laghu-udyog.gov.in/policies/state/gujarat

Sen, A. (1998) *Public Action to Remedy Hunger, Forum of Free Enterprise*, Mumbai.

Tyagi, P. (1994) *Environmental Audit in Practice in India, Proceedings of the Indo-British Workshop.* Op.cit.

Vasal, V. (1998) *Accounting for Sustainable Economic Development: Issues and Evidences, Indian Journal of Accounting,* Vol. XXXI.

World Bank, *Korea Environmental Management of SMEs and Industrial Zones for China* (2004) www.worldbank.org.

Section D

Field level Perspectives

Lean Engineering – based Technology Implementation Framework at Indian Air Force (IAF)

Pradip Kumar Ray*

Introduction

In an era of rapidly changing technological environment, tenets of Lean Engineering and Management Practices (LEAMP) may offer a number of advantages to an organization striving to achieve excellence in its operational and financial performance. Some of the guaranteed advantages of using lean-based engineering and management approaches in an organization are as follows:

(i) Integration of operations and maintenance activities with minimum inventory using Just-in-Time (JIT)-based management approaches to design, production, and supply chain processes,

(ii) Achievement of prevention-based (rather than detection-based) quality control and management at all levels of an organization,

(iii) Adoption of pull-based (rather than push-based) operation system minimizing 'blocking' and 'starving' of production lines,

(iv) Elimination of non-value adding activities or 'wastes' of different kinds by employing multi-skilled workforce and mixed scheduling approaches, and

(v) Enhancement of overall performance of supply chains with multiple authority minimizing the number of control points.

In order to bring in operational excellence in the repair and maintenance units of Indian Air Force (IAF), it seems logical and unavoidable that, considering the strategic importance of IAF in providing national security with minimum cost, maximum quality, and minimum

---

* Professor, Department of Industrial Engineering and Management, Indian Institute of Technology, Kharagpur, India.

delivery time, it should immediately start practicing lean engineering-based initiatives and management practices in its different units to realize a number of goals, such as reduced work in process (WIP), reduced lead time, reduction in defects and rejects, better use of work force potential and capability, and better product and process quality.

Keeping in view all the above-mentioned aspects of lean engineering and management, IAF expressed its desire to implement lean engineering and management approaches in 11BRD, Nasik.

Some of the key areas, noted by the IIT team, where lean engineering and management projects may make significant contribution to performance improvement are as follows:

(i) Logistics and Inventory Control practices, material management, ordering policies, and related activities,

(ii) Throughput Time at the overhaul and maintenance of aircrafts,

(iii) Task allocation, human resource allocation, grouping of work, and design of balanced production and assembly lines,

(iv) Arrival schedules of aircrafts for maintenance and repair (indicative of demand on the BRD).

Objectives and Scope of the Project Work

The objectives of the project work to be undertaken for 11BRD, Nasik are set as follows:

(i) To review the status of engineering and logistic processes with respect to lean philosophy and concepts (Objective-1),

(ii) To design and develop lean-based improved engineering and logistic processes (Objective-2).

Methodology

In order to obtain an optimal solution to the problems being encountered at present at BRD and AFS through lean-based approaches, an integrated approach leading to fulfilment of three main objectives as stated is to be followed. However, the approach or methodology to be used is dependent on the objective selected. For each objective as set, the methodology consists of a number of steps. The details of these steps against each objective are given below:

(I) Objective-1: Status review of engineering and logistic processes of AFS and BRD with respect to Lean-based concepts.

The methodology consists of the following steps:

(i) **Data Collection**: For each squadron of the AFS or BRD, the actual data on the factors and constraints as identified will be collected through direct observations, reference to history cards, and scientific judgement. Data pertaining to a number of key variables and parameters, such as set-up, processing, handling, inspection, availability, standards, workforce deployment, planning procedures, lead time, in-house capability, utilization, balance, control points, and other relevant factors will be collected at this stage. For each process or work unit, trends in relevant variables and parameters over time need to be collected. Details about the processes in terms of systems and data flow charts will be collected. Data collection instruments, such as questionnaires (with relevant items) and brainstorming (to be conducted with concerned IAF personnel) will be designed and used at this stage.

(ii) **Data Analysis**: At this stage, interactions between key variables and their impact on performance measures as per "lean" concepts will be evaluated. Performance of each squadron, as selected and defined, in terms of lean-based objectives and goals is to be measured and evaluated. Gap analysis with reference to benchmarked performance levels, value stream mapping, and quantification of wastes for each process or activity are the three critical issues to be considered at this stage.

(iii) **Review of Existing Status**: Based on the analysis of data, as mentioned in step (ii), each process is to be assessed with respect to a set of lean-based goals as applicable to AFS and BRD operations and activities. A detailed review of performance of each squadron, within a multi-objective decision-making framework, including existing databases, ERP and materials management modules, if any, under preparation or operation, will be done, keeping in view the specific conditions, constraints, and authority under which IAF activities are required to be undertaken.

(iv) **Identification of Critical Areas of Improvement**: Once the evaluation of the existing processes is done (steps (ii) and (iii)), it is expected that several problem areas will be pinpointed. In all these areas, the deviations from the accepted norms and standards are to be known for which published international standards, regulations, and guidelines with respect to performance evaluation of engineering, operations, and logistic functions of IAF (published data of developed countries) will be indicated. Work organizational issues including human resource deployment and development, irregular working hours and other work stresses of the operators, if any, are also to be thoroughly studied. Functional requirements, safety, operability, size, and maintainability of the processes, work units or squadrons as a whole are also very important to be considered in this context.

(v) **Prioritization and Potential Benefit Analysis**: Once the critical areas of improvement for each squadron are identified, actions in the form of preventive as well as corrective measures are warranted. In order to develop an effective action plan, process-based improvement projects are to be prioritized. The critical areas will be prioritized based on bottleneck analysis as well as expected benefit-to-cost ratio criterion.

(II) Objective-2: Design and Development of Improved Lean-based Engineering and Logistic Processes.

The methodology consists of the following steps:

(i) **Identification of Design Steps**: In order to design any lean-based process, relevant parameters related to basic modules of a lean-based system need to be identified, in consideration of requirement of a tailored system for IAF. Based on a thorough understanding of the system components, design steps will be charted for each process selected. Expert views and opinions arising out of brainstorming sessions to be conducted during data collection phase will be the main inputs in charting out the design steps.

(ii) **Generation of Alternate Improvement Options**: In the majority of the cases, improvement of a process may be effected through a number of means, such as continuous improvement or Kaizen, process modification, performance enhancement, new capital investment, and reallocation of resources. All the improvement options against each process will be brainstormed and assessed, on the basis of lean-based criteria. An integrated improvement framework with all possible options and their ratings will be established for each squadron. It is to be mentioned at this stage that generation of new ideas and option resulting in the possibility of significant improvement in results is the most crucial step in the design of lean-based system for an organization.

(iii) **Evaluation and Selection of Design Alternatives**: At this stage, a criteria-based scoring scheme needs to be developed. With the help of this scoring scheme, the design alternatives for a process will be evaluated and compared, in respect of three main factors, viz., quality, inventory, and delivery time. Reduction in number of control points, enhanced smoothness, increased value-adding activities, maximum utilization of existing resources, and minimum interruptions are some of the key lean-based parameters for IAF that are to be quantified and objectively analysed for each process. As a result of this exercise, the best alternatives will be selected for all the processes. Both shop-floor and management-related factors and policies will be taken into account for the purpose.

(iv) **Impact Assessment and Design of New Procedures and Systems including transition mechanism:** At this stage, effect of proposed improved procedures and system, within the framework of lean-based concepts, will be measured in terms of achievement of lean-based goals at aggregate levels. Once the key performance indicators are identified, their benchmarks or acceptable performance levels are to be suggested at this stage. New procedures and systems will be suggested on consideration of this impact. Specific situations in IAF will be kept in mind.

(v) **Suggestions for Improving Procedures, Processes, and Systems**: At this stage, requirements in terms of hardware, software, and 'humanware' are to suggested for implementing a new procedure, a process, or a system in an AFS or a BRD. Implementation costs and timeframe will be estimated for each improvement action. The strategies and action plans for implementation will be developed in consultation with concerned personnel at AFS and BRD. In this context, the consulting team will provide guidance to the implementing team of IAF for the pilot projects.

IIT Consulting Team has identified four lean engineering-based parameters or performance measures that are relevant for analysis of the operations of 11-BRD from lean engineering perspective. Although there exists a large number of lean-based issues, tools and techniques and methodologies, only a few of them may be relevant in an organisation like 11-BRD during the introductory phase of implementation of lean engineering practices.

On completion of an in-depth analysis of the problems being encountered by the squadrons of 11-BRD over the past years, it is concluded that the following lean-based issues are to be addressed for all the squadrons independently as well as 11-BRD as a whole, wherever applicable:

(i) Unevenness of workload,

(ii) Wastes of different types,

(iii) Throughput time components, and

(iv) Value adding and non-value adding activities.

The following three principal components for each of the nine squadrons of 11-BRD would lead to assessment of the present status of BRD system vis-à-vis implementation of lean engineering practices at 11-BRD:

(i) Details of unevenness of workload as identified and depicted, list of wastes of different types, list of throughput time components, and list of value adding and non-value adding activities, as observed in the existing methods of working;

(ii) Lists of 'critical' and 'very critical' causes of unevenness in workload, wastes and non-value adding activities for all the nine squadrons of 11-BRD; and

(iii) Lists of 'feasible' and 'highly feasible' remedial and preventive measures to remove the causes as identified in (ii) above or minimise their effect for all the nine squadrons of 11-BRD.

Lean-based Parameters and Performance Measures

Although a large number of inter-related issues may be required to be addressed in implementing lean engineering practices in an organisation, selection of the relevant ones among them, based on first-hand practical knowledge of the concerned personnel in critical and recurring problems being faced by the organisation, is the essential first step in implementing lean engineering practices. Based on our knowledge about the problems being faced by 11-BRD, it is felt that the following four important issues, pertaining to different operations of BRD squadrons, need to be addressed on a priority basis:

(i) Minimisation of the levels of unevenness of workload,

(ii) Minimisation of wastes of different types as applicable,

(iii) Identification and measurement of 'throughput' time components, and

(iv) Minimisation or elimination of non-value adding activities.

The implications of all these issues on the performance of the BRD system (in terms of output per unit time), as a whole or in part (at squadron level), may be significant and hence, need to be assessed quantitatively as far as practicable.

Definition of Unevenness

As has been the case, the workload at a squadron may vary over its stages of operations and/or over time (say, over month). From the lean engineering perspective, unevenness of workload across stages and time need to be measured and evaluated. Usually, unevenness of workload at a stage may be defined as the ratio of actual and planned workload (as per the capacity).

Definition of Waste

Waste refers to any work or any element of production that does not add value to the product. In the context of lean engineering, waste is classified into seven categories, viz, (i) Correction (rework), (ii) Overproduction, (iii) Processing (unnecessary), (iv) Conveyance (material handling), (v) Inventory, (vi) Motion (movement of workers, materials, production equipment or material handling equipment), and (vii) Waiting or queuing.

Definition of Throughput Time

It consists of four specific time elements: set up, processing, transport, and waiting or queuing. Usually, waiting or queuing and transport account for 65 to 80 percent of the total throughput time in many situations. Under lean engineering philosophy, efforts should be directed to identify and eliminate or at least minimize waiting and transport time. All the squadrons of 11-BRD are required to be assessed with respect to these time elements.

Value adding and Non-Value adding Activities

In most production situations, the number of value adding activities is significantly less than that of non-value adding activities, and hence, the proportion of the non-value adding activities may be very high.

The data pertaining to the above mentioned criteria are to be collected using an appropriate data collection instrument. For this purpose, a set of questionnaires has been designed. Rounds of brainstorming and interactive sessions and meetings with the implementation team members of 11-BRD at both aggregate as well as squadron levels on select items of the questionnaires as designed have been conducted for getting the required data, considered as basic inputs for status review of the existing 11-BRD system prior to suggesting implementation action plans with respect to the lean-based criteria as selected.

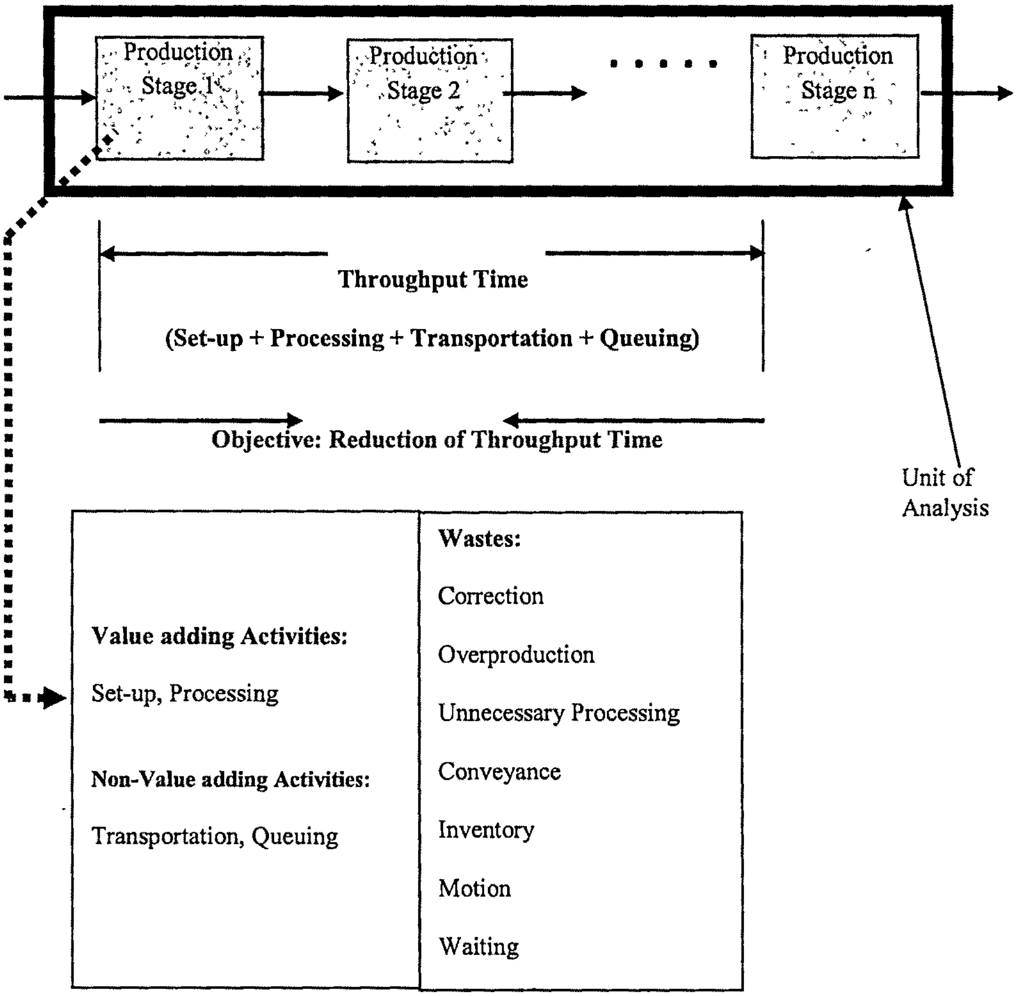
Lean-based Criteria for 11-BRD

The concepts underlying the lean-based criteria that are applicable for 11-BRD squadrons for their implementation need to be clearly explained so that they can be appropriately mapped to the existing operations of the squadrons and improvement potentials explored from lean engineering perspective. In the following subsections, the applicable lean-based criteria are explained.

Throughput Time Components

One of the objectives of lean management is to reduce the throughput time as far as possible by minimising or eliminating set-up, transport and queueing in a given unit of analysis by employing better methods, resources, technology, planning and management. Fig. 1 depicts the throughput time elements, including non-value adding activities and types of wastes for production stages in a typical production system.

Fig. 1: Throughput Time Components, Wastes and Non-Value adding Activities



Wastes and Value adding / Non-Value adding Activities

In general there are seven types of wastes that may occur in a particular production system. For analysis of the 11-BRD system from the 'wastes' perspective, the relevant wastes applicable for a given squadron are to be identified and assessed. All seven types of wastes may not necessarily be present in a given squadron.

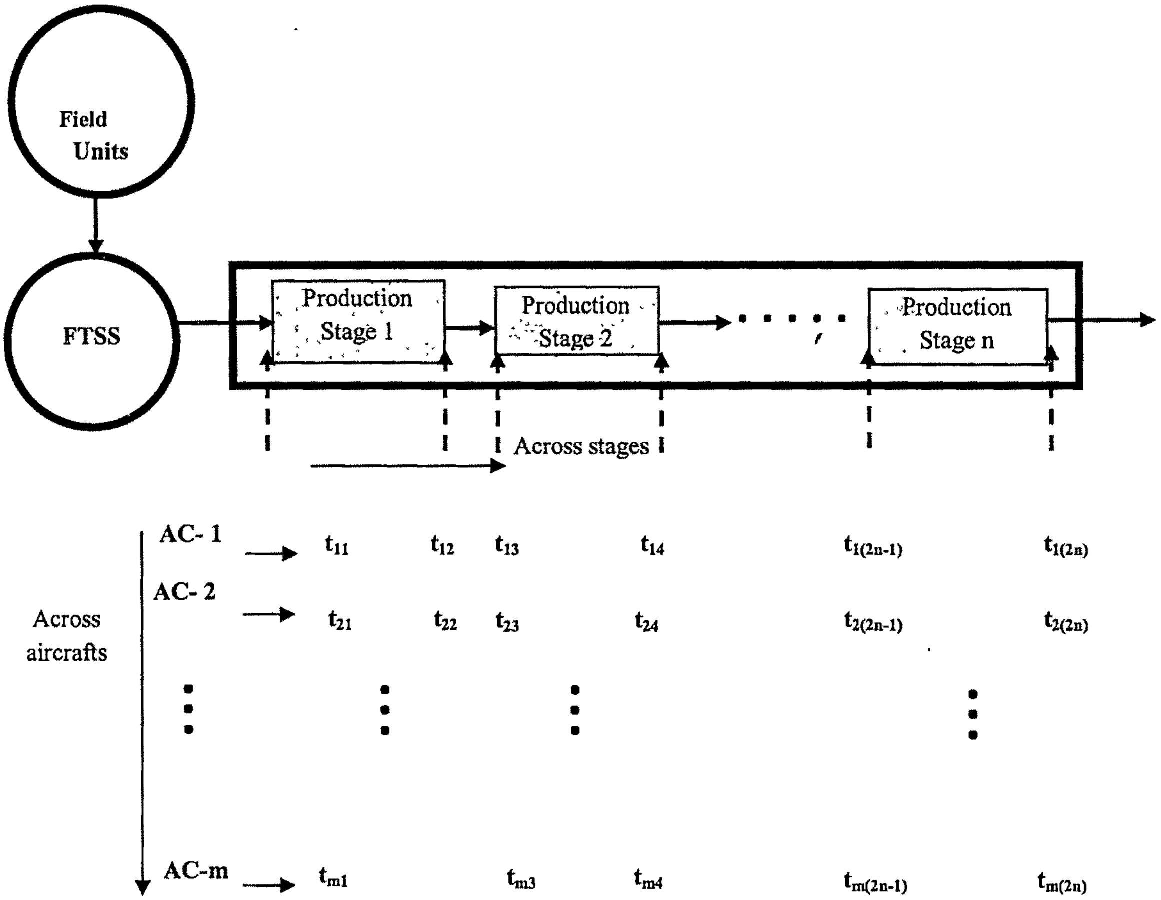
In relation to throughput time components, both 'set-up' and 'processing' are considered to be value adding. However, applying improved methods, technology and appropriate lean-based tools and techniques may reduce their times.

In non-value adding category, two activities, namely 'transportation' and 'waiting' or 'queuing' need to be focussed and addressed, and the problems arising out of them to the flow of materials or resources within a squadron are required to be solved.

Unevenness of Workload

The concept of unevenness of workload is explained below with reference to the deployment of a typical aircraft to its overhauling station (at its different stages over a period of time). The aircrafts are being inducted in a sequence, and the timings between the start and finish of a particular stage, between end time of the previous stage and start time of the succeeding stage for a given aircraft, and the timings between successive inductions of the aircrafts are taken into consideration for measuring and assessing the unevenness of workload. The relationship between the unevenness of workload and the flow of resources has been explained with reference to a typical overhaul squadron, as shown in Fig. 2.

Fig. 2: Unevenness of Workload and Flow of Resource.


Field Units
FTSS
Production Stage 1
Production Stage 2
Production Stage n
Across stages
Across aircrafts
AC- 1
AC- 2
AC-m
t_{11} t_{12} t_{13} t_{14} $t_{1(2n-1)}$ $t_{1(2n)}$
t_{21} t_{22} t_{23} t_{24} $t_{2(2n-1)}$ $t_{2(2n)}$
t_{m1} t_{m3} t_{m4} $t_{m(2n-1)}$ $t_{m(2n)}$

Referring to Fig. 2, the following aspects and conditions related to flow of resources within the overhaul section from lean engineering perspective are relevant:

(i) Condition for no delay and no waste between stages

$t_{13} = t_{12}, t_{15} = t_{14}, \dots, t_{m(2n-2)} = t_{m(2n-1)}$

(ii) Condition for no delay and no waste within a stage

$t_{21} = t_{12}, t_{31} = t_{22}, \dots, t_{m1} = t_{(m-1)2}$

(iii) Flow of resources over stages

In order to implement lean management, one of the most fundamental rules is to maintain the flow of 'resources' over the production stages in a given unit of analysis at the maximum possible rate.

The flow of resource depends on ($t_{12} - t_{13}$), ($t_{14} - t_{15}$), etc. over the stages of an aircraft, as well as on ($t_{21} - t_{12}$), ($t_{23} - t_{14}$), etc. over the aircrafts.

If the 'within' differences are more, the flow rate is reduced. It should be the constant endeavour of the management to reduce these timing differences as far as practicable so that the flow rate is maintained at an increased level.

The same concept is applicable for all types of squadrons.

(iv) Factors affecting flow rates of resources

Factors pertaining to both internal and external to a particular squadron are affecting the flow rate of resources. Some of the internal factors are: availability of manpower/equipment/material, rotation of manpower, other kinds of problems, breakdown, etc. Similarly, some of the external factors are: aggregate plan, schedule, randomness in aircraft arrival etc.

As has been the case, both ($t_{21} - t_{12}$), ($t_{23} - t_{14}$), etc. and ($t_{12} - t_{13}$), ($t_{14} - t_{15}$), etc. depend on both internal and external factors.

Methodology for Analysis

Broadly the framework for analysis of 11-BRD system, from the perspective of lean engineering, involves the following steps:

Step-1: In-depth understanding of the lean-based concepts as applicable to individual squadrons and 11-BRD as a whole.

Step-2: Identification of relevant lean-based factors and their components (over time and over stage) for an individual squadron.

Step-3: Data analysis resulting in preventive and remedial measures for improvement in performance, and their prioritisation.

Step-4: Effect analysis through simulation modelling.

Step-5: Cause identification and enumeration (internal and external).

Data Collection on Lean-based Parameters / Performance Measures

Introduction

In order to collect data for assessment of 11-BRD squadrons with respect to the lean engineering-based criteria as mentioned, a number of brainstorming sessions and meetings were conducted wherein appropriately designed questionnaires for data collection were administered. In particular, the following three questionnaires have been designed and used:

(i) **Level-1 questionnaire** on "Assessment of BRD system in terms of lean engineering-based criteria"

(ii) **Level-2 questionnaire (Part-I)** on "Assessment of BRD system in terms of lean engineering-based criteria (Cause enumeration and remedial measures for each squadron/function)"

(iii) **Level-2 questionnaire (Part-II)** on "Assessment of BRD system in terms of lean engineering-based criteria (Ranking of causes and remedial measures for each squadron as identified)"

Data Collection

The questionnaires were administered to all the nine squadrons of 11-BRD. Whereas for Level-1, the squadron commanders had been the respondents, for Level-2 the persons working at the operations level were the respondents to the questionnaire items. The kinds of analyses carried out on the responses obtained are mentioned for each kind of questionnaire.

Responses to Level-1 Questionnaire

The responses were obtained on all the items of the Level-1 questionnaire on completion of a number of interaction and brainstorming sessions. It was found that the respondents were able to correlate their understanding of the lean-based criteria as mentioned to the working procedures, methods and resources utilised in their work areas.

Responses to Level-2 Questionnaire (Part-I)

The Level-2 questionnaire has two parts: Part-I and Part-II. Part-I deals with identification of causes and remedial measures against the problems classified under lean-based criteria for different stages of a given squadron. The respondents from all the squadrons actively took part in all the interaction and brainstorming sessions in order to prepare an exhaustive list of causes affecting adversely the performance of the squadrons as well as remedial and/or preventive measures required to remove such causes. It is assumed that the responses were based on an in-depth understanding of the lean-based concepts as well as thorough analysis of the existing data and performance pertaining to a given squadron. As a matter of fact, the common causes hindering 11-BRD as a whole to perform as per lean requirements have also been identified.

In order to facilitate specific corrective actions, the causes and remedial measures have been identified, for different work stages of a squadron. Specifically, the following information is obtained for each squadron:

(i) Causes of unevenness of workload and possible remedial measures,

(ii) Causes of wastes of different types and possible remedial measures,

(iii) Causes of occurrence of waiting, transport and set-up components of throughput time and possible remedial measures, and

(iv) Causes of occurrence of non-value adding activities and possible remedial measures.

Responses to Level-2 Questionnaire (Part-II)

The items in Level-2 questionnaires (Part II) pertain to data collection on ranking of causes and remedial measures as identified in Part-I for each squadron. The causes related to unevenness, wastes and non-value adding activities are to be ranked in terms of their 'criticality', and the remedial measures as identified in terms of 'feasibility'. For ranking of each cause or remedial measure, a four-point scale was used for criticality and feasibility, respectively. In order to maintain uniformity in the responses from all squadrons and concerned persons, the definitions of scale values for both criticality and feasibility were provided to the respondents (definitions are provided in the questionnaire).

On completion of a number of interaction and feedback sessions, the meaningful responses were obtained. As we are concerned with mainly the 'most critical' and 'critical' causes (from the point of view of level of negative impact on performance) and 'highly feasible' and 'feasible' remedial measures (from the point of view of ease of implementation as far as possible with the present level of resources), the responses are classified under these categories only for each squadron against all the four identified lean-based criteria.

Prioritisation of Remedial Measures

As has been observed, there are a large number of remedial measures identified against the causes for a given squadron by the respondents. Out of these measures to be undertaken, it is logical to assume that only highly feasible and feasible measures are required to be implemented on a priority basis to address the causes of unevenness, wastes and non-value adding activities. Keeping this point in mind, the lists of causes and remedial measures have been prepared for each squadron.

Benchmarking of 11-BRD System

Benchmarking for the components of the system as mentioned and their usability in 11-BRD context are briefly described in the following sections:

Product Benchmarking

The product benchmarking concerns with comparing the design of MIG 29/23 aircrafts with other internationally available fighter aircrafts in the market with respect to the maintenance, repair and overhaul function. An explicit comparison is necessary only when there is a possibility of changeover from one design to another. Moreover, facilitating the creation of a lean-based system being the primary goal, actual data pertaining to effect of the design parameters of the other aircrafts on the relevant lean-based parameters are to be made available if such an exercise is necessary and undertaken.

We are of the opinion that the product benchmarking is not possible at this stage as the data are not available from the open source. Moreover, as far as the fulfilment of the objectives of the project is concerned, product benchmarking may not necessarily lead to implementation of improved lean-based operations management at 11-BRD as it is dependent on the local conditions and constraints.

Process Benchmarking

For carrying out process benchmarking for a squadron, data pertaining to the state-of-the-art processes for maintenance, repair and overhaul are required. As it is assumed at this stage that the processes are to be performed as per the standard practices for a Russian aircraft, there is no need to carry out the process benchmarking. However, certain basic issues affecting the process performance may be earmarked for benchmarking. Three issues are as follows:

(i) Work methods and procedures,

(ii) Process reengineering through implementation of IT-based tools and software, and

(iii) Lean-based tools and techniques for data analysis and process performance improvement.

The work methods and procedures that are being followed at 11-BRD are unique and specific to situations. Improvement in work methods and procedures would be effected by implementing the remedial and preventive measures as identified. Constant methods improvement initiative may also lead to achievement of best or benchmarked performance in course of time.

The concept of 'process reengineering' is to be initiated at the earliest at 11-BRD. As it is observed that many critical causes as identified pertain to non-availability or delayed availability of data from the existing information system as well as inadequacy in the software in use, the process can be reengineered for better performance by modifying the existing IT-based tools and by incorporating the required features and modules in the information system. In this context, many of the implementation initiatives are related to use of specific databases, modules and tools, such as simulation in the information system facilitating analysis and control of performance with the help of lean-based tools and techniques.

For continuous analysis of the 11-BRD squadrons as per lean-based parameters, it is necessary that standard tools and techniques are used. For monitoring the performance of a squadron, with reference to a target performance level, the use of such tools and techniques may result in identification of the potential gaps between what is required and what is achieved. The standard 'spider diagram' is required to be used for the said purpose.

These tools and techniques are briefly introduced in the following sections:

Lean-based Tools and Techniques for Benchmarking

These tools and techniques are of two types: (i) those used for analysis of data, and (ii) those used for performance improvement. Against each of the lean-based parameters, the following tools and techniques are available and used if they are feasible for a given squadron.

Lean-based Parameter: Unevenness of Workload

The following tools and techniques may be used:

(i) **Aggregate Production Planning**: Aggregate Production planning is concerned primarily with determining optimal production, inventory, and work force levels to meet the demand. A number of strategies are available to management to absorb the demand fluctuations. A suitable combination of these strategies should be explored to develop an optimal aggregate production plan.

(ii) **Flow-Shop Scheduling**: Flow Shop Scheduling Problems, or FSPs, are a class of Group Shop Scheduling Problems in which the operations of every job must be processed on machines *1, 2,..., m* in this same order.

(iii) **Mixed Model Loading**: The concept of manufacturing and assembling a range of products simultaneously is defined as mixed model production, which is mainly applicable in a typical respective manufacturing system.

(iv) **Modular Design**: For most manufacturing items, there is a conflict in designing a basic product to satisfy a wide range of customer options while retaining low production costs and other advantages associated with mass production. In modular design, this conflict is resolved by designing a product with minimum number of standardized components and then allowing product differentiation in the final assembly phase. This modular design is extensively used by many industries.

(v) **Layout Planning**: A technique which establishes a step-by-step planning procedure allowing users to identify, visualize, and rate the various activities, relationships, and alternatives involved in a layout project.

(vi) **Group Technology and Cellular Manufacturing System (CMS)**: Group Technology or GT is a manufacturing philosophy in which the parts having similarities (Geometry, manufacturing process and/or function) are grouped together to achieve higher level of integration between the design and manufacturing functions of a firm. The aim is to reduce work-in-progress and improve delivery performance by reducing lead times. The application of Group Technology to manufacturing is called Cellular Manufacturing.

(vii) **Concurrent Engineering**: Concurrent Engineering (CE) is a systematic approach to integrated product development that emphasizes the response to customer expectations. It embodies team values of co-operation, trust and sharing in such a manner that decision making is by consensus, involving all perspectives in parallel, from the beginning of the product life cycle.

Lean-based Parameter: Wastes of Various Types

The following tools and techniques may be used:

(i) **Work Flow Diagram**: It shows the movement of material, identifying areas of waste. Aids teams to plan future improvements, such as one piece flow and work cells.

(ii) **Visual Management**: It is a set of techniques that makes operation standards visible so that workers can follow them more easily. These techniques expose waste so that it can be prevented and eliminated.

(iii) **Kaizen**: It is the Japanese term for continuous improvement. In manufacturing, Kaizen relates to finding and eliminating waste in machinery, labour or production methods.

(iv) **Poka Yoke (Fool-proofing)**: It is an extremely cost-effective lean manufacturing tool, using very simple devices to prevent the production of defective products. There are typically three types: (a) Contact Type, (b) Constant Number Type, and (c) Performance Sequence Type.

(v) **Error Proofing**: Error Proofing is a structured approach to ensure quality and error free manufacturing environment. Error proofing assures that defects will never be passed to next operation.

(vi) **Autonomation**: Providing machines and operators the ability to detect an abnormal condition and stop working immediately is called Jidoka. Jidoka is sometimes called autonomation, meaning automation with human intelligence.

(vii) **Jidoka / andon**: It is a manufacturing term referring to a system to notify management, maintenance, and other workers of a quality or process problem. The centerpiece is a signboard incorporating signal lights to indicate which workstation has the problem. The alert can be activated manually by a worker using a pull cord or button, or may be activated automatically by the production equipment itself. The system may include a means to stop production so the issue can be corrected. Some modern alert systems incorporate audio alarms, text, or other displays.

(viii) **5S Programme**: 5S is a programme used by leading Japanese companies to foster efficiency, maintenance and continual improvement. 5S is abbreviated from the Japanese words Seiri (Housekeeping), Seiton (Workplace Organization), Seison (Cleanup), Seiketsu (Cleanliness), and Shitsuke (Discipline), are simple but effective methods to organize the workplace.

5S is a necessary foundation on which all other improvement initiatives must be built. By implementing the 5S methodology, a company can reduce waste hidden in the workplace, improve the levels of quality and safety, reduce lead times and costs, and increase profitability.

(ix) **Gemba**: It is a Japanese term meaning "the actual place" or "the real place" and implies that it is the place where value is created. In lean manufacturing, the idea of gemba is that the problems are visible and the best improvement ideas will come from going to the gemba. The gemba walk, much like MBWA or Management by Walking Around, is an activity that takes management to the front lines to look for waste and opportunities to practice Gemba Kaizen or practical shop floor improvement.

(x) **Shainin**: It is like Taguchi in some ways, but a range of statistical tools and techniques for developing an understanding regarding the complex interactions between a significant number of input variables and output variables. It is a powerful means of eliminating waste - a fundamental principle of lean manufacturing. Examples of techniques include "Multivariate Charts".

(xi) **Yo-i-don**: Yo-i-don refers to a coordinated approach to simultaneous production of parts or sub-assemblies for assembly into a next-stage sub-assembly.

Lean-based Parameter: Throughput Time Components

The following tools and techniques may be used:

(i) **SMED** (Quick Changeovers): SMED (Single Minute Exchange of Dies) is the theory and the technique for performing setup operations in fewer than ten minutes, the number of minutes expressed in a single digit. SMED was developed by Dr. Shigeo Shingo to slash equipment changeover times in the Toyota production system. Using Dr. Shingo's techniques, leading Japanese manufacturers have reduced even the most complex changeovers and setups to less than ten minutes.

(ii) **Standard Rate of Work**: The length of time that should be required to set up a given machine or operation and run one part, assembly, batch, or end product through that operation. This time is used in determining machine requirements and labour requirements.

Lean-based Parameter: Non-Value adding Activities

The following tools and techniques may be used:

(i) **Synchronous Flow Manufacturing**: A synchronized flow of product must be achieved for maximum speed, flexibility, and distance. In traditional manufacturing operations, it is difficult to realize these objectives because of long setups and/or changeovers, work-in-process and inventory queues, poorly designed systems, and unreliable manufacturing with sub-optimal material movement. Synchronous Flow Manufacturing works by eliminating non-value-added activities and concentrates on simplicity, speed and velocity of product flow to flex the factory to the customers' needs.

(ii) **Value Added to Non-Value Added Lead Time Ratio**: This provides insight on how many value-added activities are performed compared to non-value-added activities, using time as a unit of measure.

This provides insight on how many value-added activities are performed compared to non-value-added activities, using time as a unit of measure.

Gap Analysis

A typical gap analysis results in determination of significant differences, if any, between the actual levels of the lean-based criteria in the existing system and the corresponding levels of the same criteria when lean-based tools and techniques are applied. Essentially, it is an analysis of the performance differentials between the existing system and the proposed system with lean-based tools and techniques in use.

A majority of the remedial and preventive measures as identified for implementation requires the use of one or more of the lean-based tools and techniques as mentioned. The effect of implementing remedial measures will be determined during Stage-3 of the project. The expected performance improvement can be measured with the help of appropriate simulation models. The simulation model, which has already been developed in this respect, will be discussed in a subsequent chapter. Thus gap analysis vis-à-vis benchmarked tools and techniques will be completed in Stage-3 of the project.

Critical Areas for Improvement and Potential Benefits

During the brainstorming and interactive sessions conducted with the managerial and operations level personnel of all the squadrons of 11-BRD, various kinds of problems being faced by 11-BRD have been identified. Many of these problems may be addressed with a lean engineering-based approach. The work areas where these problems occur have been identified in a systematic manner. It is assumed that the maximum improvement in the performance may be realised if these critical areas are appropriately considered.

The ongoing lean engineering initiative at 11-BRD will bring in best possible results once the remedial measures as identified are implemented within a planned timeframe. Squadron-wise critical areas of improvement in this context as well as the potential benefits are identified.

Basic Implementation Approach and Conclusions

Implementation Approach

For each of the remedial measures, particularly for 'highly feasible' and 'feasible' measures, the implementation approach should be judged with respect to a number of issues or factors. Judgement on these factors may lead to making a feasible time schedule for implementation.

A practically feasible time schedule for each remedial measure as identified for a squadron may be developed only when the decision maker(s) does/do have assessment on the factors (1 to 5) as listed in Table 1.

Table 1: List of Factors for Lean Implementation

1. Major action steps needed to remove the causes
2. Independence of Decision Making: (i) Squadron Level (ii) AOC Level (iii) MC Level (iv) AF HQ Level
2. Types of Actions Required: (i) Equipment replacement (ii) Substitution of materials (iii) New materials (iv) New methods (v) Training programme for operators (vi) Implementation of lean-based tools
3. Level of Investment: (i) Major (ii) Minor (iii) Within budget
4. Level of Uncertainty
5. Major Bottlenecks / Barriers, if any, to be Overcome
6. Time Schedule to Implement
8. Change in the Information System/ Documentation: (i) Major (ii) Minor

Lean Engineering and its Usefulness in Aircraft MRO

Lean Engineering is defined as a systematic approach for achieving significant and continuous improvement in the performance of a system through the elimination of all kinds of wastes of time and resources in its total business process.

A well-designed and developed lean philosophy may help an aircraft MRO achieve competitive advantage through associated benefits, such as superior maintenance, reduced repair time, reduced wasted motion, reduced inventories, and life cycle cost. Its implementation ensures not only the quality of aircraft system, but also improvement in the other related factors like man and environmental system. Nowadays, the concept of lean engineering is widely implemented in Indian Air Force (IAF), Boeing, Pratt &Whitney, and many other organisation and companies. Several aircraft MRO operations have adopted lean engineering as a business strategy to transform their operations. They mainly utilize five principles: setup reduction, visual workplace, point of use tooling, point of use inventory, and one piece flow to significantly improve their processes.

The majority of organisation runs Kaizen (continuous improvement) events to energize personnel and rapidly improve a process or an area of their facility. The lean approach revolutionized the Programmed Depot Maintenance lines for F-15 and C-5 aircrafts generating dramatic payback for the war-fighters in the form of reduced repair time, increased on-time return of aircrafts to the field, and lower maintenance cost. For example, the on-time return of F-15 aircraft to the active fleet increased from 12 percent in the year 2000 to 80 percent in the year 2004. The on-time return of C-5 aircraft to the active fleet increased from 25 percent in the year 2000 to 100 percent in the year 2004. Lean practices reduced the average flow time for depot maintenance on C-5 from 339 days in the year 2000 to 240 days in the year 2004.

Characteristics of Lean-based Processes

The characteristics of lean processes are manifold. With the introduction and implementation of lean engineering practices, an organization's processes must have a majority of the following characteristics:

i. Highly customer focused,

ii. Single-piece flow production,

iii. Just-In-Time materials/pull systems,
iv. Short cycle times,
v. Quick changeover,
vi. Continuous flow work cells,
vii. Connected processes with machines, equipment, tools and people,
viii. Less space and resources requirements,
ix. Multi-skilled cross-trained employees,
x. Flexible workforce,
xi. Empowered employees,
xii. Everyone involved with continuous improvement,
xiii. Highly organized and safe work areas, and
xiv. Improved quality with major reductions in defects.

Lean Implementation and Role of In-House Implementation Team

For lean implementation to be successful there must be a balance between two important components of lean: the hardware and the software. Hardware refers to the tools and techniques and software refers to the human side of the implementation. While there is more publicity on the success and power of the tools and techniques of lean, the devil is actually on the human side. The lean implementation failures are not only due to failure to grasp the tools and techniques, but also failure in change management. Thus, in order to implement lean process in aircraft maintenance, both the factors are to be considered. In this context, a number of conditions and requirements are essential for implementation of lean engineering practices in an organization.

Implementation process starts with the formation of a formal lean implementation team by the top management that will provide the support and resources required to start the process. Without the commitment and dedication of the team, no progress in implementation is possible. In this context, the top management needs to be totally committed. They must want to implement lean engineering and be prepared to wholeheartedly support any projects it spawns. For lean implementation, the following aspects should be strictly adhered to:

i. prepare and motivate the team people for the work: create common understanding of need to change to lean.
ii. employee involvement: share information and manage expectations.
iii. identify and empower champions, particularly operations managers: Make it both directives yet empowering.
iv. atmosphere of experimentation: be tolerant of mistakes, be patient, and be willing to take risks.

Main Responsibilities of Lean Implementation Team for Aircraft MRO

The following responsibilities of a lean implementation team are worth mentioning:

(i) **Outline Actions:** Outline all the actions required to eliminate wastes in all areas like inventory or flow, integrate the supply chain, and rely on employee participation to drive continuous improvement.

(ii) **Start with Back Shops:** Implement lean philosophy to aircraft back shops, such as engine pylon shop, landing gear, and production support centre in order to reduce the flow time.

(iii) **Evaluation and Inspection:** It is a core maintenance task in aircraft MRO. Evaluate the traditional system of assigning the deport maintenance work and adopt new way to keep a smooth flow across work cells.

(iv) **Create Dock Cell:** The dock cell should be created in three steps: Pre-dock cell, dock cell, and post-dock cell. The pre-dock cell consists of a dedicated team of mechanics and support staff who are responsible for de-fueling, de-arming, de-painting, stripping and inspecting the aircraft. The team inspector conducts a thorough examination of air craft and inputs all identified problems into a database which is used to create next cell, called dock cell, that is responsible for removing main landing gears, installing pylons and landing gears, sorting and rearranging the work area. The lean events like rigging, fuel, paint, functional tests, etc are to take place in this post-dock cell.

(v) **Just-in-Time Management System:** JIT is a system that produces the required item at the time and in quantity needed. It simulates the new direction of planning and performing activities in MRO.

(vi) **Kaizen Implementation:** It should be implemented in MRO for continuous improvement. It embraces every aspect of the lean implementation. Such a programme should be a part of every business as it provides the framework for any valuable change no matter how small.

(vii) **Kanban System:** Whenever we cannot implement continuous flow in production and on time delivery of aircraft, a production trigger based on lean repair practices, controlled batch size and a Kanban system are required to be utilized.

(viii) **Policy Deployment:** Communicate the vision to the whole company through meetings and presentations. Some companies call this activity as policy deployment.

(ix) **Master Plan:** Develop and post the master plan, which is in fact the lean implementation plan with some additions, to reflect other aspects of the MRO, such as safety or morale.

In summary, an example of a lean implementation programme must have the following ingredients:

i. Senior Management to agree and communicate their lean vision.

ii. Management brainstorms to identify project leader and set objectives.

iii. Communicate plan and vision to the workforce.

iv. Ask for volunteers to form the Lean Implementation team (a group of 3 to 5 person is best, drawn from different departments).

v. Appoint members of the Lean Manufacturing Implementation Team.

vi. Train the Implementation Team in the various lean tools. Make a point of trying to visit other non-competing businesses, which have implemented lean.

vii. Select a project of MRO and run it for 2 to 3 months, then learn from own mistakes.

viii. Evaluate results and encourage feedback.

Human-Environment Interaction-based Performance Measurement System at a Steel Plant in India

Pradip Kumar Ray*

Introduction

As a multidisciplinary subject the principles of ergonomics can be applied to the study and design of the components of any work system involving human(s) and machine(s) embedded in an environment, and as such its areas of application are not limited by a particular technology or by the scale of the system. In essence, application of these principles provides a standardized approach to the analysis of any work system with emphasis on consideration of interaction between human(s), machine(s), and environment. In this context, Tata Steel, Jamshedpur has been earnestly striving to apply the ergonomic principles, at its worksystems at different levels in order to ensure safety, health, convenience, and comfort of the personnel at their workplaces, level of productivity, and reliability of the overall system.

In this context, there is a compelling need to develop a framework to determine the levels of ergonomic performance of different workplaces. It has also been the opinion of the management in many instances that the factors of performance and/or operations where deficiencies or non-conformances occur should be identified and assessed on a regular basis to improve the performance, productivity, and reliability of any unit of analysis, and application of the concept of "remedial" ergonomics in many areas, operations, and factors of production may lead to substantial improvement in overall system performance. An assessment tool for determination of the status (level of ergonomic maturity) and level of ergonomic intervention to be employed in a given work system is all that is needed.

---

* Professor, Department of Industrial Engineering and Management, Indian Institute of Technology, Kharagpur, India.

Objectives

Keeping in view that identification and assessment of the effective variables contributing towards the overall performance of a human-machine system is the primary requirement for which an Ergonomic Performance Indicator (EPI) is proposed to be designed and developed. Hence, the objectives of the project are set as follows:

(i) to identify and characterize the ergonomic variables for a given work system with regard to work efficiency, operator safety, and working conditions,

(ii) to design a comprehensive Ergonomic Performance Indicator (EPI) for quantitative determination of the ergonomic status (in terms of design requirements and performance levelling) of a given work system or unit of analysis, and

(iii) to apply the EPI model to assess the degree of ergonomic maturity of a given work system or unit of analysis.

As decided by the management of the Tata Steel the functional scope of the project includes all types of work systems and production units as identified by the concerned personnel of Tata Steel. Initially, a general framework of the assessment tool is needed before it is validated with respect to several representative work systems of Tata Steel as decided by the management.

Basic Concepts

In order to design an Ergonomic Performance Indicator (EPI) for determination of the ergonomic status of a given work system, modelling a general framework involving all relevant ergonomic factors is the essential first step. Assessing the degree of ergonomic maturity against each identified factor is the next important step.

The ergonomic factors to be considered in almost all situations or work systems are related to four key aspects of work systems, viz, human characteristics, physical workspace, physical environment, and organizational factors.

While assessing the level of an ergonomic factor, three principal parameters need to be looked into, viz, work efficiency, operator safety, and working condition, each of which needs to be defined and interpreted in the widest possible sense during evaluation. The principal parameters are defined as follows:

'Operator Safety' refers to either levels of outputs obtained per unit of time, or optimum time utilization, or minimum error rate in tasks, or efficiency in manual handling, or minimum energy expenditure rate by the person(s) concerned in a given work system.

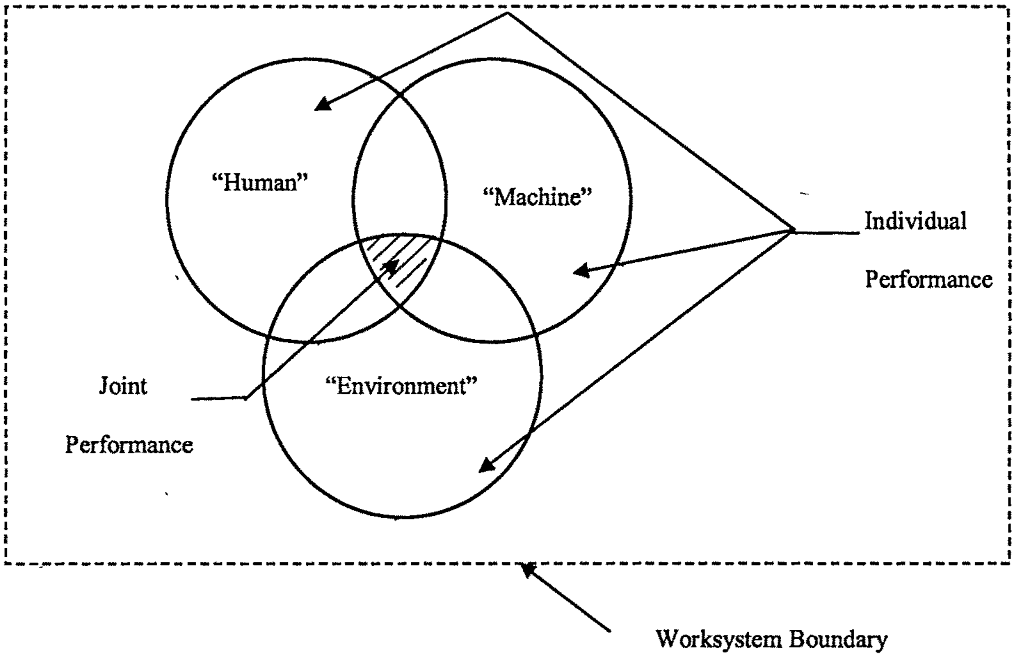
'Work Safety' may be interpreted in terms of potential danger to health associated with the tasks, deteriorating fitness of the individual concerned, possibility of injuries and accidents, and hazards of any other kind.

'Working Condition' refers to the condition or environment in the workplace and its surroundings made available to the satisfaction or dissatisfaction and comfort or discomfort of the person(s) concerned.

In essence, the performance of any work system is a reflection of the joint effect of performance of the individual components of the work system, viz. 'human', 'machine', and 'environment', as illustrated in Fig. 1.

It is reasonable to assume that for a work system to be capable of performing at its maximum level, each component must also contribute significantly and equally to the overall performance of the work system as a necessary condition for an acceptable work system. However, the central focus of ergonomics being the human(s) in a work system, the main consideration in the design of EPI is to measure and assess the state and the effect of human(s) in the work system, as a sufficient condition for sustained ergonomic performance. Hence, in order to assign values to the base parameters in EPI modelling, the effect on each component needs to be considered.

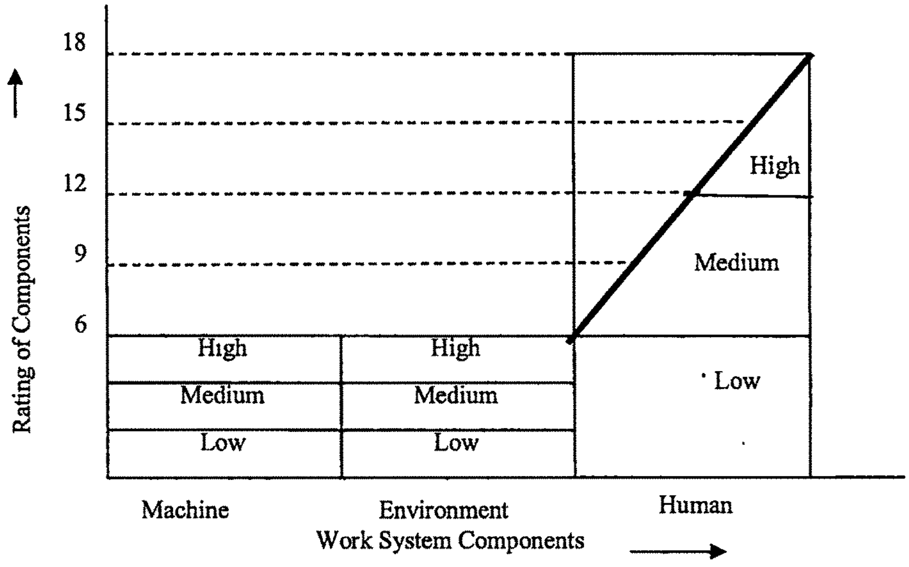
Fig. 1: Overall Work Systems Performance: A Joint Effect of Individual Performance of Human, Machine, and Environment Components



Concept of '6' (CO-6)

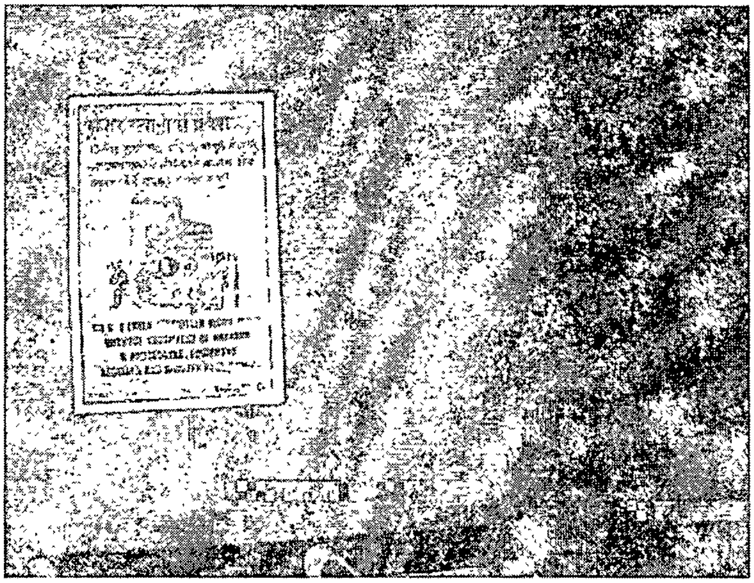
The three major components of "human", "machine", and "environment" have been assigned equal weightage while assessing the overall performance of a given work system. Against a base parameter, a three-level (L-I, L-II, and L-III) performance rating scale is recommended. For L-I, since the machine and the environment have the highest contribution and the human has the least contribution signifying the level of ergonomic maturity of the system, the total contribution of machine and environment is worked out to be 6.6 in a scale of 0-10. For simplicity and convenience of use, a rounded off figure of 6 has been assigned to this level. Following the same logic, other two levels (L-II and L-III), depending on their ergonomic maturity, have been assigned a maximum score of 12 and 18, respectively. The generic concept of "6" (CO-6) is illustrated in Fig. 2.

Fig. 2: Generic Concept of CO-6



Concept of 'Safety Awareness' (CO-SA)

In the overall assessment of any type of work system (manufacturing or non-manufacturing, including service or office activities), various kinds of training programmes on safety may be initiated for the working personnel through safety campaign, and introduction of safe working methods. With regard to such conditions, it is proposed to assign an additional scale rating in a scale of 0-10, on the basis of the intensiveness of safety programmes existing in the work system.



Concept of 'Three Dimensions (3-D)' in EPI

The application of the ergonomic concepts ensures an adequate level of work efficiency, operator safety, and working condition in a work system. These parameters of performance are linked to four classes of ergonomic factors as has already been mentioned. In developing an Ergonomic Performance Indicator (EPI) model, the interrelationships between the principal and base parameters (in all possible combinations) are judged, and their impact on overall ergonomic performance is appropriately determined and evaluated for a given work system. The whole concept of EPI implementation may be viewed in a 3-D manner viz. the breadth of base parameters along X-axis, depth of base parameters along Y-axis, and the time of application along Z-axis (Fig. 3). Therefore, in the modelling of an EPI structure, the ergonomic performance is considered to be the "bull's eye", the level of which may be rated in a (0-100) rating scale. The other layers before the bull's eye are the outer layer-base parameters and inner layer-principal parameters (Fig. 4). Further Fig. 5 indicates the evolutionary structure of EPI through consideration of base and principal parameters.

Fig. 3: 3-D Approach in Design of EPI model

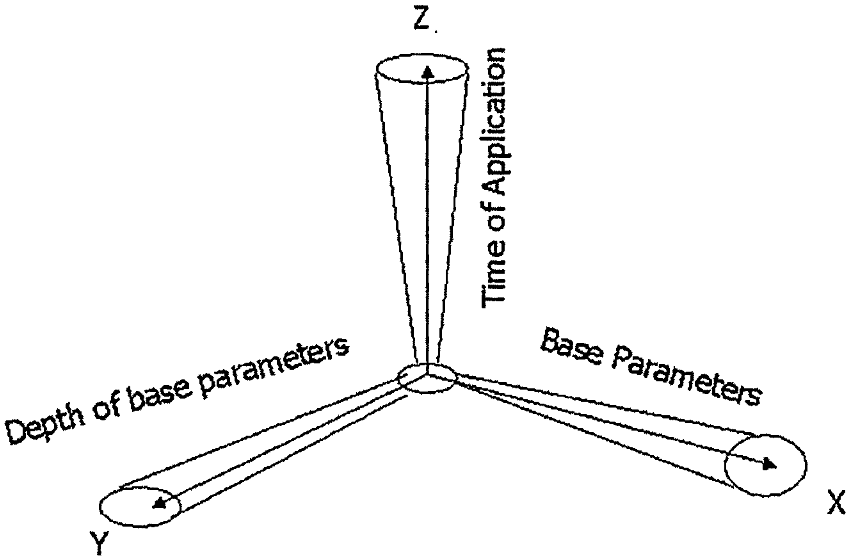


Fig. 4: EPI Structure

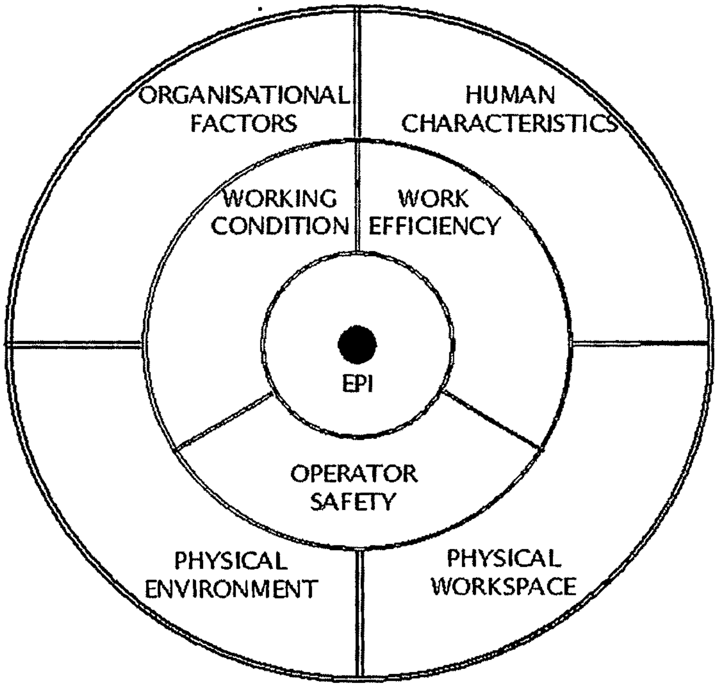
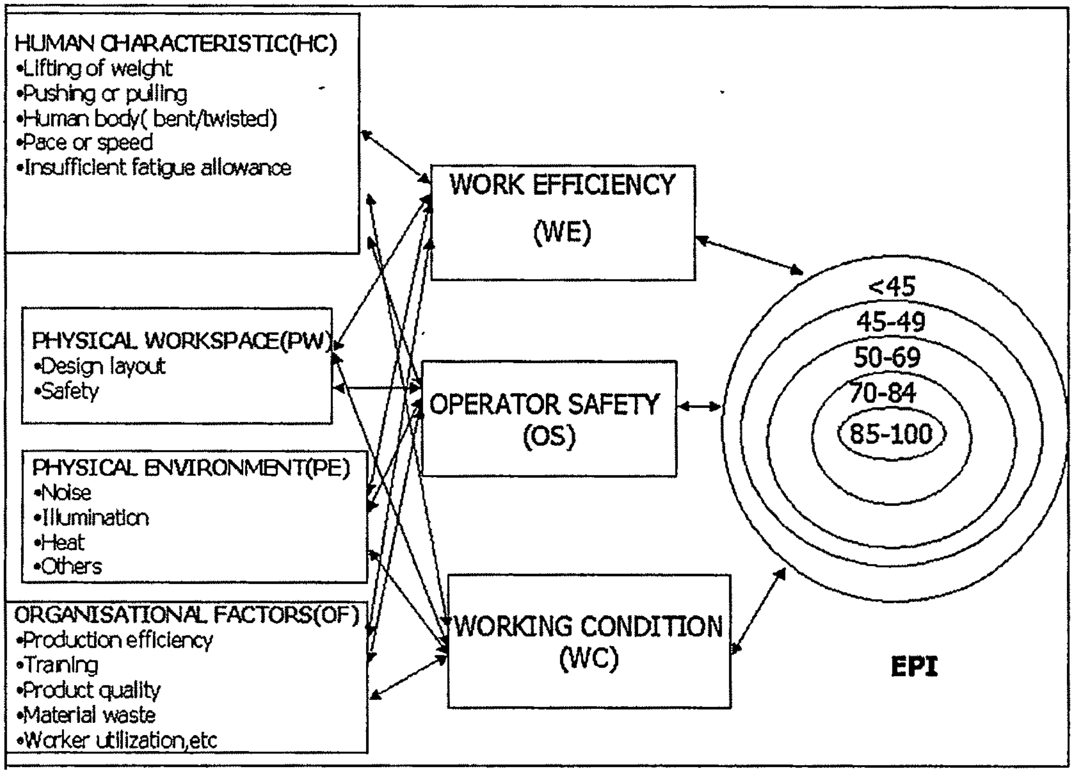


Fig. 5: Principal and Base Parameters in EPI



Methodology

The important steps of the methodology leading to the design and development of the EPI assessment tool are as follows:

Identification of Ergonomic Factors

A general framework involving all relevant factors and sub-factors related to human characteristics, physical workspace, physical environment, and organizational factors is required to be developed including the procedures and norms to be followed for a given unit of analysis (work system). A structured data collection form, called EPI data record sheet (version 1) and coded as EPI-DRS-1, has been designed to elicit information and individual judgment on the ergonomic factors.

Identification of Design and Performance Factors

A list of factors related to three specific aspects, viz. operator safety, work efficiency, and working condition including functional requirements, if any, is prepared and standardized at this stage. Wherever feasible and desired, these factors are objectively analyzed with respect to their current levels and/or implications; otherwise, they are subjectively assessed.

Initially, to identify all the possible ergonomic factors so as to have adequate breadth (coverage) and depth (intensiveness) in the EPI model, information on several ergonomic aspects in each factor needs to be considered. With an in-depth understanding of the prevailing situations and requirements of workplaces, several aspects representing depth of each factor may be identified.

Development of Interaction Matrix

At this stage, the interactions (strong or weak) between the ergonomic and design or performance factors to be ascertained for a given unit of analysis was prepared in order to limit the number of factors with which a given work system may be assessed to a reasonable size. The guideline for the selection of appropriate number of factors is established. The rules for determining the relative weights (reflecting importance or criticality of a factor in the presence of other factors, or on its own) were specified at this stage.

Design of the Assessment Tool

On completion of the above three steps a comprehensive framework for (1) determining the ergonomic performance of a work system (the basic EPI model), (2) identification of deficient area(s) in relation to ergonomic factor(s), and (3) setting the priority of improvement actions suggested, is established at this stage. Therefore, a structured methodology for measuring ergonomic performance of a work system is developed.

Testing and Validation of Assessment Tool (EPI) in Varied Situations and Work systems

The proposed tool is to be tested for its verification, validation, and applicability in a number of representative situations. Appropriate modification of the assessment tool is required to be made based on actual observations, review of opinion of concerned personnel, and performance evaluation.

EPI Model: Characteristic Features

The details of the EPI model designed and developed for Tata Steel, Jamshedpur, are described in four parts. In fact, the model may be referred to as an Ergonomic Capacity Assessment in Production System Utilization Level or E-CAPSUL for Tata Steel. Part-I lists the ergonomic factors to be considered in the general model for EPI, as well as the guidelines for quantitative assessment of base parameters in the design of EPI. Part-II refers to the tables required to be used to compute the EPI score of a given worksystem. There are five tables listed. Table 2 details the definition of scale values for levelling and rating of the ergonomic variables. Table 3 details the scale values under different specific conditions for assessment of visual environment; Table 4(a), 4(b), and 4(c) detail the scale values under different specific conditions for assessment of thermal environment which requires (i) assessment on radiant temperature, (ii) assessment on air speed, and (iii) assessment on relative humidity; Table 5 details the scale values under specified conditions and jobs for assessment of auditory environment. The data given in Tables 4 and 5 are applicable in acclimatized conditions. Table 6 lists the possible EPI grading of a work system under consideration as well as status and actions for improvement, if any. Part-III describes the systematic process of determining the EPI score of a given work system in 8-step procedure.

Part-I

This section is designed to understand and quantitatively assess the importance of base parameters for a work system. In order to help define, assess, and quantify a parameter in the most logical and objective way, each ergonomic factor with its scale value is required to be defined for an objective assessment of base parameters. It is opined that the conditions as described in the guidelines are an exhaustive representation of different working conditions and systems at the present level of technology at Tata Steel.

It is recommended that the analyst studies the prevailing conditions against the following 15 factors considered, with regard to key principal parameters; viz. work efficiency, operator safety, and working condition, and 'matches' with those given in the guidelines.

F1. Pace or speed of work under the control of the operator

(i) The operator has to work with utmost care, attention, high pace, and cannot distract attention; failure results in waste/reworking; continuous flow.

(ii) The operator can work in a relaxed mood; failure may not necessarily result in wastes/reworking; intermittent flow.

(iii) The operator has to work separately in the jobs assigned at a place, and can easily manipulate the pace of work; process pace is not a significant factor for operator pace of working.

F2. Adequacy of fatigue allowances for jobs

(i) The work results in tiredness very soon; recovery time from fatigue is more; engaged in dangerous and/or heavy work; may result physical and mental stress or both.

(ii) The work results in tiredness when work duration is substantial; recovery time is fast; not engaged in dangerous or heavy work; may result physical and mental stress occasionally.

(iii) The operator feels at ease in coping up with the workload; enjoys the jobs; no evidence to suggest that the worker is mentally or physically stressed or overworked.

F3. Workers away from their workplace during work

(i) The operator feels extremely uncomfortable while working; cannot work continuously at the stipulated workplace, and leaves the workplace with virtually no control on his or her movements by the management; actual working time less than or equal to 50% of the total available working time consistently.

(ii) The operator leaves the workplace at an infrequent interval although the condition at the workplace and the job characteristics may not necessarily compel the operator to do so; the operator is engaged in work, most of the time.

(iii) The operator does not like leaving the workplace at all during the working time.

F4. Occurrence of "human" errors

(i) Human errors may occur due to improper equipment design or performance; may result in catastrophic economic loss, and endanger human life of the self and other persons directly or indirectly affected; elaborate and detailed study as well as alternate technology needs to be employed.

(ii) Human errors may occur with no significant economic loss and no chance of major equipment failure or musculoskeletal injury; the operator may not feel safe in some situations.

(iii) Human errors may occur with no significant economic loss or body injury or accidents; the operator becomes aware about the implication of errors, and is in a position or trained to overcome the problem on his/her own initiative.

F5. Frequency of lifting of weights

(i) The operator has to manually lift a weight at a high frequency at a regular pace as the present level/type of workplace requires; "alternatives are not available".

(ii) The operator has to manually lift a weight at a low frequency at a regular pace as the level/type of technology requires; "better alternatives are not available".

(iii) The operator may have to manually lift weight at a predetermined interval; no physical stress; "alternatives may be available."

F6. Force required to push or pull objects

(i) The working condition and the method of doing work make pushing or pulling objects very difficult; the operator has to exert a lot of physical effort either individually or in a group; a permanent feature of the existing working method and condition at the workplace.

(ii) The working condition and working method make pushing or pulling objects somewhat difficult; the operator has to exert physical effort individually; an important feature of the working condition and the method at the workplace.

(iii) The working condition and method of working are such that pushing or pulling objects is not at all difficult for the operator; the type of technology employed makes the job very easy to undertake; indicative of existence of convenient and safe working methods and norms.

F7. Movements of human body

(i) During manual material handling, body movements are primarily bending, or twisting; producing excessive compressive stress on body joints with a high risk of spinal injury.

(ii) During manual material handling, frequency of bending and/or twisting movements is less and under control; there is less risk of musculoskeletal injury.

(iii) The design of the work method is such that no such body movements occur in most cases; chance of musculoskeletal injury is most unlikely.

F8. Assessment of visual environment in the workplace

(i) The amount of illumination as measured for the job does not conform to the standards: 50% or more off the standard (Refer to Table 3).

(ii) The amount of illumination as measured for the job does not conform to the standards: within 50% off the standard (Refer to Table 3).

(iii) The amount of illumination as measured for the job is conforms to the standards (Refer to Table 3).

F9. Engineering Anthropometry

(i) Mismatch between work system and operators concerned at extreme level with frequent reporting of complaints;

(ii) Mismatch between a few work systems and operators concerned with no apparent reporting of complaints;

(iii) No mismatch whatsoever between the work system and the operators concerned.

F10. Work Posture

(i) Existing work postures in majority of the cases are unacceptable with serious negative consequences in the long run.

(ii) Existing work postures do create imbalance and discomfort in some situations or jobs in the workplace.

(iii) Working postures do not affect adversely productivity and quality, and are not at all considered a problem.

F11. Assessment of thermal environment in the workplace

(i) It is concluded that the actual thermal environment of the work system under consideration conforms to the standards with regard to radiant temperature, humidity, and airflow within an acceptable limit (Refer to Table 4).

(ii) It is concluded that the actual thermal environment of the work system under consideration does not exactly conform to the standards with regard to radiant temperature, humidity, and airflow at the workplace on the basis of the deviation from the standards (Refer to Table 4).

(iii) It is firmly concluded that the existing thermal environment of the work system under consideration is judged comfortable for the majority of the persons engaged; a sustained acceptable productive effort in the existing environment is guaranteed (Refer to Table 4).

F12. Workers complain about physical environment in their workplaces

(i) In terms of severity of potential hazards in the physical environment, there are high task demands and high risk of musculoskeletal injury; worker complaints are supported by facts; permanent total disability/long term health problems may exist or will occur.

(ii) In terms of severity of potential hazards at the workplace, task requirements exceed the mental and physical capabilities of some workers; complaints of these workers are supported by facts; permanent partial disability is likely.

(iii) Task requirements are difficult for some workers, but within their capabilities; minor injury likely but major injury is very unlikely; there are hardly any complaints reported.

F13. Tasks resulting in excessive material wastes

(i) The material wastes generated at the workplace severely restrict the productive effort of the workers concerned; it is also a critical problem in relation to the working environment for almost all jobs.

(ii) The material wastes generated at the workplace restrict the productive effort of the workers concerned in some jobs only; it may not adversely affect the quality of the working condition.

(iii) The material wastes generated at the workplace are not considered a problem; there is no reporting of any adverse effect on the working condition.

F14. Repetitive motions / frequent use of hand tools / both hands and feet operating / same posture / information overload / insufficient time to sense and respond to signals / physical fitness / knowledge of training

(i) It is observed that the productivity of the person(s) concerned is severely affected by one or more of the factors such as repetitive motions, frequent use of hand tools or levers, physical fitness, level of training, fatigue (whole body or local), overexertion, slip/trip and musculoskeletal injury considered as critical problem areas at the workplace for almost all the jobs.

(ii) It is observed that the productivity of the person(s) concerned is restricted by one or more of the factors only for a few jobs, and the problem areas, as mentioned are not at the critical level.

(iii) It is observed that the workplace consideration is not affected, more or less, by such factors as mentioned. The worker(s) concerned is/are mentally and physically fit, and exert(s) productive efforts for the jobs assigned.

F15. Assessment of Auditory Environment

(i) It is concluded that the existing auditory environment of the workplace under consideration does not conform to the standards established for maximum intensity of sound and total allowable exposure time on the basis of deviation from the standards (Refer to Table 5); there is a strong feeling that permanent hearing loss may occur unless preventive/corrective measures are taken immediately or in near future.

(ii) It is concluded that the existing auditory environment of the workplace under consideration does not conform fully to the prescribed standards (Refer to Table 5).

(iii) It is concluded that the existing auditory environment of the workplace under consideration conforms to the standards established for maximum intensity of sound, and corresponding total allowable exposure time (Refer to Table 5); slight deviation from the standards may occur only sometimes without any adverse effect to the workers engaged/concerned with no complaints whatsoever from the workers.

Part II

Value Assigned to Ergonomic Variables (Base Parameters)

Each ergonomic variable or base parameter to be considered should be levelled and quantified, on a pre-defined scale, once the conditions are known to the analyst. Based on the consideration of the ergonomic effect of the specified conditions on the components of the worksystem, each condition is required to be quantified.

For determining the scale values of a specified ergonomic variable a three-point scale is found to be applicable, feasible, and easily implementable. Each scale value, for which a level number is given, indicates a numeric ergonomic assessment score of a given situation or worksystem, based on the degree of maturity in the "human" component at the existing level of technology (defined in terms of "machine" and "environment" components). The definition of each level is provided in Table 2. The scale rating (SR) has been developed using the concept of 6 (CO-6).

Table 2: Levelling and Rating of Ergonomic Variables: Definitions of Scale Values

Level Number	Definition	Degree of Maturity in relation to			Scale Rating (SR)
		Machine	Environment	Human	
L-I	The "Machine" and "environment" components of the worksystem under consideration predominantly contribute to the level of overall performance and system output, and the human component is not considered with regard to human comfort, safety, and job satisfaction. The human component is passive / reactive in nature.	High	High	Low	6
L-II	The "machine" and "environment" components of the worksystem under consideration contribute to the level of overall performance and system output, with human components able to do its functional role. The person(s) concerned does/do have the feeling of comfort, safety, and job satisfaction. The human component is active / proactive in nature.	High	High	Medium	12
		Medium	Medium	Medium	11
		Medium	Low	Medium	10
		Low	Low	Medium	9

Table 2 (Contd.): Levelling and Rating of Ergonomic Variables: Definitions of Scale Values

Level Number	Definition	Degree of Maturity in relation to			Scale Rating (SR)
		Machine	Environment	Human	
L-III	The "machine" and "environment" components of the worksystem under consideration contribute positively to the level of overall performance and system output, with human components interacting perfectly with other components. The person(s) concerned does/do have the feeling of maximum comfort, safety, and job satisfaction. The human-machine and human-environment interfaces make the whole worksystem an ideal one under the present level of restrictions / constraints / technology.	High	High	High	18
		Medium	Medium	High	17
		Medium	Low	High	16
		Low	Medium		15
		Low	Low	High	15

While rating a given condition, it is quite probable that the degree of maturity of either "machine" or "environment" or "both" may also be medium or low. Under such conditions, the scale value is required to be suitably modified towards the lower side.

Table 3: Assessment of Visual Environment: Data in Lux

Job	Condition		
	(i) Illuminance (Lux)	(ii) Illuminance (Lux)	(iii) Illuminance * (Lux)
Locality and stress areas	450-750	225-450	150-300
Packing area, mould preparation, engineering workshop / machine shop	750-1200	450-750	300-500
Office work, inspection areas	1200-1800	750-1200	500-800
Drawing office, garage/repair/tool room, precision work	>1800	1200-1800	800-1200

* Any value below 150 lux may be poorly rated

Table 4: Assessment of Thermal Environment: Data for Acclimatized Condition

(a) Assessment on Radiant Temperatures in °C

Activity/ Job		Condition								
		(i)	(ii)				(iii)			
	Rating	6	9	10	11	12	15	16	17	18
Office work		32-34	30	28	26	24	22	20	18	16
Light job, Active worker		36-38	35	33	31	29	28	27	26	25
Heavy work, Active worker		39-42	38	37	36	35	34	33	32	31

(b) Assessment on Air Speed in meter/second

Activity/ Job		Condition								
		(i)	(ii)				(iii)			
	Rating	6	9	10	11	12	15	16	17	18
Office Work		.05	.07	.08	.09	.10	.11	.12	.13	.14
Light Job, Active worker		.22	.25	.26	.27	.28	.30	.31	.32	.33
Heavy work, Active worker		.30	.33	.34	.35	.36	.38	.40	.42	.44

(c) Assessment on Relative Humidity in percentage

Activity/ Job		Condition								
		(i)	(ii)				(iii)			
	Rating	6	9	10	11	12	15	16	17	18
Office work		65-75	62	60	58	55	52	48	44	40
Light job, Active worker		65-75	62	60	58	55	52	48	44	40
Heavy work, Active worker		65-75	62	60	58	55	52	48	44	40

Table 5: Assessment of Auditory Environment: Data for Acclimatized

Condition with Protective Aids in dB (A)

Activity/ Job		Condition								
		(i)	(ii)				(iii)			
	Rating	6	9	10	11	12	15	16	17	18
Office work		95-105	94	93	92	87-90	86	84	82	80
Light job, Active worker		95-105	94	93	92	87-90	86	84	82	80
Heavy work, Active worker		95-105	94	93	92	87-90	86	84	82	80

Part-III

Steps for Determination of EPI

The steps to be followed for obtaining the EPI score of a worksystem are as follows:

Step-1 : Select the principal parameter(s) relevant for the worksystem under consideration.

Step-2 : Select the base parameter(s) influencing the identified principal parameter(s) in Step-1.

Step-3 : Assess the situation against each base parameter considered and assign its scale rating (SR) from Table 2.

Step-4 : Repeat Step-3 for all other base parameters selected.

Step-5 : Compute the sum of scale ratings (SRs) obtained in Step-3 and Step-4.

Step-6 : Assess the intensiveness of safety programmes adopted, and assign an appropriate CO-SA rating in a scale of (0-10).

Step-7 : Compute the total ratings obtained in Step-5 and Step-6.

Step-8 : Compute the normalized total rating (NTR) in a scale of (0-100).

EPI Grading

The normalized total rating (NTR), as obtained in Step-8 above may be graded on a 5-point class scale given in Table 6.

Table 6: EPI Grading of Worksystems

Type of worksystems	Range of NTR	Grade	Remarks
Class-I	85-100	Excellent	Maintain the prevailing work conditions.
Class-II	70-84	Very Good	Comparatively acceptable work condition; may initiate remedial steps wherever required.
Class-III	50-69	Good	Acceptable work condition with a great scope for improvement; a time-bound ergonomic intervention required.
Class-IV	45-49	Poor	Work condition not acceptable; needs immediate ergonomic intervention.
Class-V	< 45	Very Poor	Work condition is rejected; large scale investment and/ or intensive management involvement required.

Determination of EPI Model for a Worksystem

Case-I: Blast Furnace (A-F)

Department: RM & IM

Item	**Data Collected or Information Available**	**EPI Factor Influenced**	**Rating Assigned**
HC-6	Hole shifting of skip line rope, Mudgun changing, Lorry car cylinder changing	F1. *Pace or speed of work under the control of the operator*	**6**
HC-7	Bogies of CT car and lorry car, mudgun arm and power arm, UTA boxes	F2. *Adequacy of fatigue allowances for jobs*	**6**
HC-3	Gauge rod changing, Handling of Tuyer stock, Wire rope changing (skip and bills)	F5. *Frequency of lifting of weights*	**6**
HC-4	Tuyer changing, Mudgun changing, Wire rope changing	F6. *Force required to push or pull objects*	**12**
HC-5	City car or lorry car component changing, wire rope changing, cast house equipment like mudgun and drill machine	F7. *Movements of human body*	**15**
PE-2	Stoke house operation, furnace top equipment inspection, cooling plants piping inspection	*F8. Assessment of visual environment in the workplace*	**6**
PW-2	Wire clamp inspection of skip drive, CT car etc.	*F9. Engineering Anthropometry*	**6**
PE-4	Tuber stock changing near non drainable tap hole area, tough patching operation, cleaning of skip pit, store area of all furnaces, furnace top area of each furnaces, high line operation, store operation, cost house operation	*F11.Assessment of thermal environment in the workplace*	**6**
PE-5	Maintenance of lorry car equipments, dust value of dust catcher, mudgun equipments, furnace top equipments like small bell, big bell, lockers and begs.	*F12. Workers complain about physical environment in their workplaces*	**6**
HC-8	Tuyer stock changing, Tuyer changing, mudgun fixing, tuyer stock changing, drift motor changing, wire rope changing, bogie changing of CT car and lorry car, tuyer stock changing always standing, gauge rod changing standing	*F14. Repetitive motions / frequent use of hand tools / both hands and feet operating / same posture / information overload / insufficient time to sense and respond to signals / physical fitness / knowledge of training*	**12**
Total			**81**

CO-SA =8

So, TSR = 81+8=89

Maximum Scale Rating = 18 x 10 = 180

Maximum TSR= 180+10(CO-SA)

= 190

So, NTR= TSR/Maximum TSR

= 89/190

=0.47

EPI Grade of the Worksystem = Poor

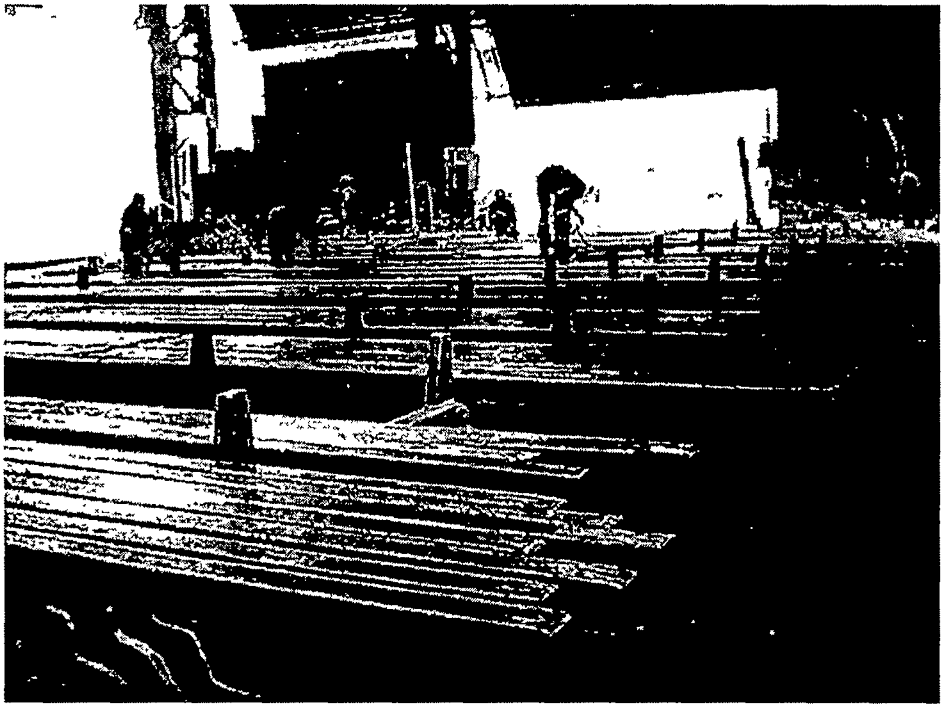
Remarks

Work condition not acceptable.

Needs immediate ergonomic intervention

Case-II: Merchant Mill

Department: Long Products



Item	Data Collected or Information Available	EPI Factor Influenced	Rating Assigned
HC-6	Packing & strapping of furnished base, scale removal from the furnace, removal of cutting from cold shear	F1. *Pace or speed of work under the control of the operator*	12
HC-7	Pushing out the billets from the furnace, crane drives in finishing & stripping section, pulpit B operates while seeing loop in the bar	F2. *Adequacy of fatigue allowances for jobs*	6
HC-3	Removal of bullet front and cuttings, removal of scale from mill tunnel, sorting on the holdup bed	F5. *Frequency of lifting of weights*	6
HC-4	Billet tilting on conveyer roll prior to furnace, putting motor house breaker in or taking out, pulling and pushing oxygen and weight cylinder trolley	F6. *Force required to push or pull objects*	6
HC-5	Seeing the entry and exit guide setting, alignment of TMT heeding, alignment of pendulum shear with roughing	F7. *Movements of human body*	6
PE-2	Face area, gas lines water seal etc, cold shear area, bearing shop for roll assembly, billet yard	*F8. Assessment of visual environment in the workplace*	9
PW-1	Cleaning and maintenance below gearbox, cleaning below cold sheets and cold sheet 2	*F10. Work Posture*	6
PE-4	Charging bed conveyer roll area prior to furnace, billet pushing cabin, billet withdrawing cabin, crane operator cabin, pushing cabin on the backside of the furnace, crossover bridge for inspection of cooling bed, crane drivers cabin, withdrawal & twist pinch roll operator's cabin, cold sheet operator rear sheet	*F11.Assessment of thermal environment in the workplace*	9
PE-5	Grinding operation while guides are grinded, face area hydraulic purees platform, TMT heads presume gauge display	*F12 Workers complain about physical environment in their workplaces*	6
HC-8	Cutting from behind near cold sheet bars to be removed and sorted manually, twist pinch roll operator, twist pinch roll operator critically operates control using both hands, changing bed pulpit operator, motor house substation in charge, pulpit operator. This person when asked to tilt the billet which have got struck midway inside the furnace, when new system in hydraulic/pneumatic was commissioned all the people did not have appropriate knowledge of training.	*F14. Repetitive motions / frequent use of hand tools / both hands and feet operating / same posture / information overload / insufficient time to sense and respond to signals / physical fitness / knowledge of training*	9
PE-1	Face area, cold sheet 1, cold sheet 2,roller's cabin where grinding of guides is done, big dia base moving on the roller from the shuffle bar	*F15. Assessment of Auditory Environment*	6
Total			**81**

CO-SA =5

So, TSR = 81+5=86

Maximum Scale Rating = 18 x 11 = 198

Maximum TSR= 198+10(CO-SA)

= 208

So, NTR= TSR/Maximum TSR

= 86/208

=0.452

EPI Grade of the Work system = Poor

Remarks

Work condition not acceptable.

Needs immediate ergonomic intervention.

Green Development

Anjan Ghosh*

Abstract

Environmental protection has a very high priority in Exide and several steps and initiatives are taken to improve Environmental Performance. All the seven plants are certified to ISO 14001 Environmental Management System. This goes beyond compliance to Pollution Control Board norms and continuous efforts are on towards reduction of pollution, reduction of waste, conservation of natural resources, energy saving etc. The Environmental Policy is comprehensive and is extended to supplies, which are expected to act on the intent of the Policy. The Quality Policy also mentions a clean environment. A policy for Occupational Health and Safety is also established. The currently implemented policies are given below.

Introduction

Environmental Policy of Exide

We at Exide Industries in the pursuit of our Core Value of Responsible Corporate Citizenship and our vision of caring for environmental protection are committed to the issues addressed in this policy, throughout the organization.

It is the Policy of the Company to:

- Minimize the adverse impact of our activities, products and services by implementing an effective environmental management system.
- Prevent pollution through waste minimization at the source, treatment and/ or recovery of emissions and releases; conservation of energy; recycling and optimum use of resources.
- Continually improve our environmental performance through setting and reviewing appropriate objectives and targets and their periodic evaluation.

---

* Vice President, Exide Industries Ltd., India.

- Demonstrate commitment to comply with applicable legal requirements and other requirements related to our environmental aspects.
- Communicate with all interested parties and all people working for or on behalf of our organization.

Signed by MD & CEO

6th December 2010

Quality Policy of Exide

We at Exide Industries Ltd. in the pursuit of our Core Values of Customer Orientation and Striving for Excellence, are committed to the issues addressed in this policy, throughout the organization. It is the policy of the company to:

- Provide satisfaction to customers by designing, manufacturing and marketing products and services that consistently meet their needs and expectations and comply to all applicable requirements.
- Implement and maintain a Quality Management System that meets International Standards.
- Continually improve the effectiveness of our Quality Management System through setting and reviewing appropriate quality objectives and targets and their periodic evaluation.
- Communicate with all interested parties and all people working for or on behalf of our organization.
- Ensure its continued suitability in line with business direction.
- Contribute towards a cleaner environment.

Signed by MD & CEO

7th June 2011

Occupational Health & Safety Policy

We at Exide Industries Limited, believe in our core values of Striving for Excellence and Responsible Corporate Citizenship and hence are committed to providing a healthy and safe working environment throughout the organization.

It is the policy of the company to :-

- Ensure that operations and processes, are safe and free from risk to health.
- Comply with all applicable legal and other requirements related to identified OH & S risks.
- Ensure continual improvement in our OH & S Management System and its performance by setting and reviewing objectives and targets.
- Educate and involve persons, working under the control of it, in OH & S activities.

This OH & S Policy shall be made available to interested parties.

EXIDE

MD & CEO
3rd December 2007

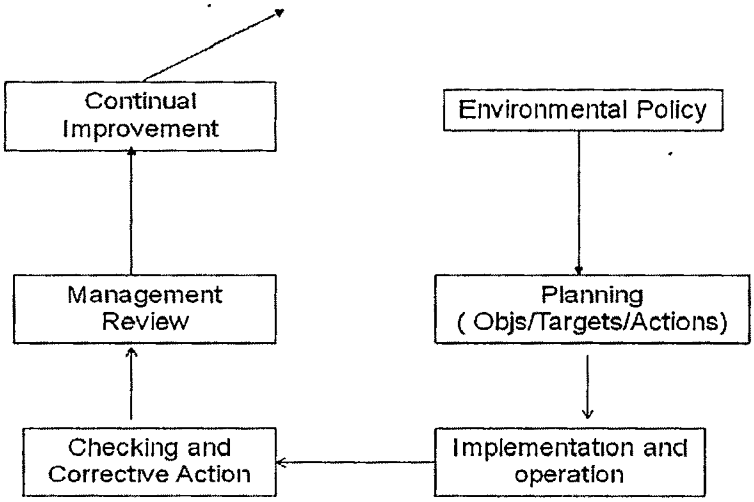
THE EMS STANDARDS USED

ISO 14001: 2004 - EMS- Requirements with Guidance for use

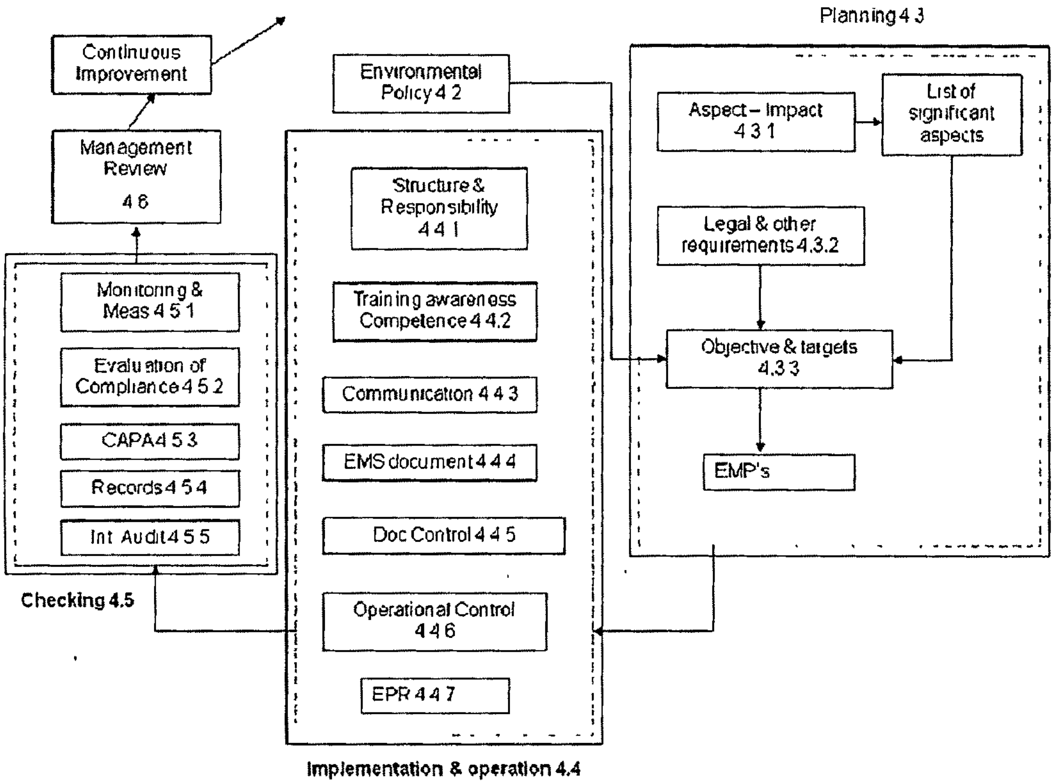
ISO 14004: 2004 - EMS - General Guidelines on Principles, System and Supporting Techniques

ISO 19011: 2011 -Guidelines for QMS / EMS Auditing-General Principles

Basic Structure of the EMS MODEL (following Plan-Do-Check-Act Cycle)


Continual Improvement
Environmental Policy
Management Review
Planning (Objs/Targets/Actions)
Checking and Corrective Action
Implementation and operation

EMS 14001 Model in Detail

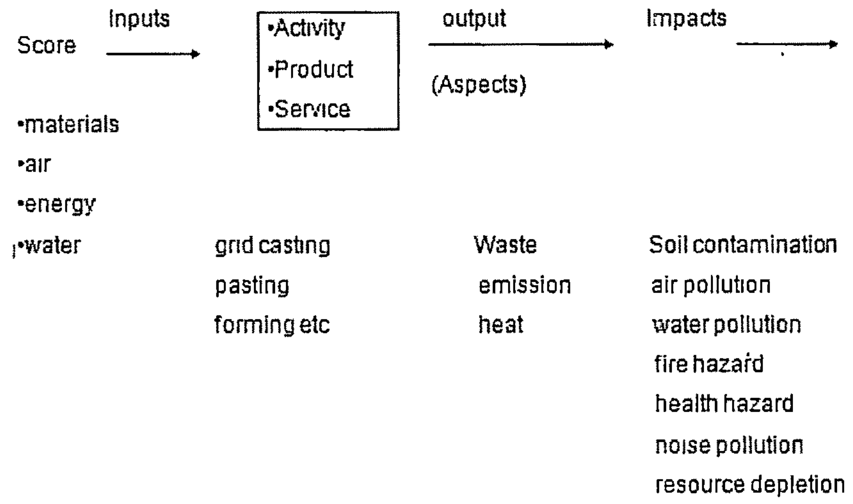


EMS ASPECT - IMPACT STUDY (as per clause no. 4.3.1 of ISO 14001:2004)

These studies are done for each and every activity in the plants and environmental scores are calculated based on several factors like probability of occurrence, severity of impact, duration of impact, control mechanism, detectability.

Aspect: element of an organisation's activities, products or service that can interact with the environment.

Impact: any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisations activities, products or services.



Some of the Environmental & Pollution Laws that are fulfilled

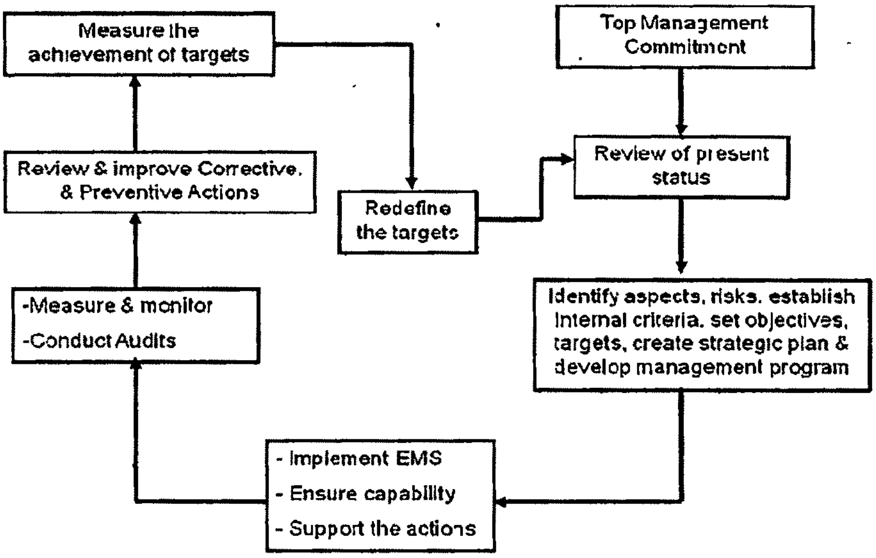
- The Factories Act
- West Bengal Factories Rules
- Environment Protection Act / Rules
- Hazardous Wastes Management and Handling Rules
- Manufacture, Storage and Import of Hazardous Chemical Rules
- Batteries Management & Handling Rules
- Air (Prevention & Control of Pollution) Act / Rules

- Water (Prevention & Control of Pollution) Act / Rules
- National Environment Tribunal Act
- Noise Pollution (Regulation & Control) Rules
- Ozone Depleting Substances (Regulation & Control) Rules
- Plastics Manufacture, Sale & Usage Rules
- Explosives Act

Prevention of Pollution planning and initiatives

- Source reduction or elimination
- Material substitution
- Efficient use and conservation of energy/material resources
- Reuse and recycling
- Recovery and treatment
- Control mechanisms

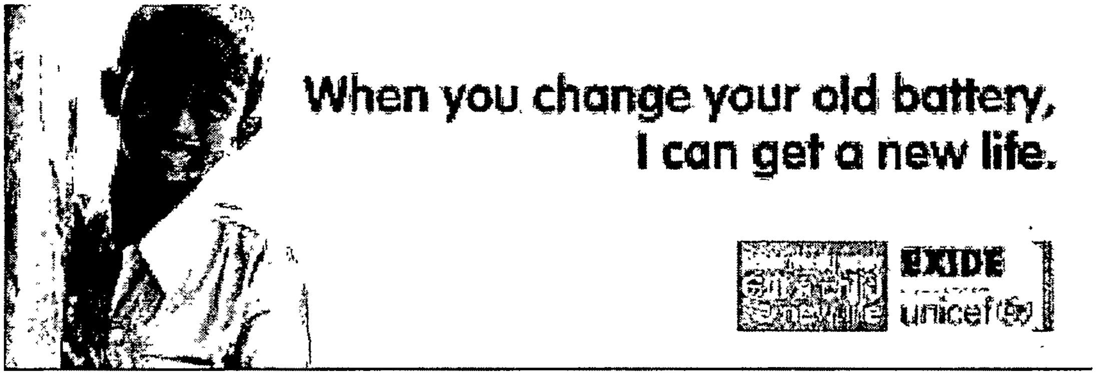
CONTINUAL IMPROVEMENT CYCLE FOLLOWED


Measure the achievement of targets
Top Management Commitment
Review & improve Corrective, & Preventive Actions
Redefine the targets
Review of present status
-Measure & monitor
-Conduct Audits
Identify aspects, risks, establish internal criteria, set objectives, targets, create strategic plan & develop management program
- Implement EMS
- Ensure capability
- Support the actions

Awareness campaign on Environment:

Corporate Social Responsibility

End of life batteries are collected back from the market and sent to smelters where the lead is recovered and recycled back to the plants for making new batteries. The customer is given discount on the returned batteries. On top of that Exide donates to UNICEF money for the batteries returned for child welfare. The images below are put on the packaging carton boxes.


When you change your old battery,
I can get a new life.
Gift a child a new life
EXIDE
unicef

Gift a child a new life

EXIDE

unicef

When you return a used battery to any of our authorised dealers,
we contribute on your behalf, to UNICEF's Child Environment Programme.
It would help change the lives of the underprivileged children
who are in dire need of water, sanitation and hygiene in schools.
Your contribution would help save our environment as well.
Lead, a major component in your car battery, if not handled
responsibly, can harm the environment and our health.
Return your used car battery and make the world a better place.

THIS CARTON IS FOR TRANSPORTATION ONLY

Spreading Awareness:

Recognition for Environmental Performance:

EXECUTIVE CHAIRMAN receiving TERI Corporate Environmental Award

CESC Limited - Environment Management & Pollution Control Initiatives at Generating Stations

Kushal Bhowmick[*]

Company's Environment Policy

Following the guidelines provided by the National Environment Policy and keeping with the objectives of meeting ever increasing demand of power, CESC have framed a comprehensive Environment Policy.

We believe that our commitment towards the well-being of the living, preservation of the non-living and protection of the environment in which we operate, is an integral part of the power generation process. We recognize our obligation both locally and globally and to the present and future generations and shall adopt best possible practices of environmental management for maintaining the ecological balance.

Thermal power plants are categorized as one of the grossly polluting industries anywhere in the world. Thus our responsibility towards environment is enormous and therefore to prosper in our business by protecting the environment and achieving sustainable development we have set our goals and to meet the goals time bound actions are taken.

Our Goals include not only ensuring compliances with all applicable statutes but also achieving internal standards which are more stringent than the statutes. The existing processes are improved upon and new processes are devised. Techno-economically viable state of the art technologies are also adopted to achieve the in house standards. Environmental performances and its impact on environment are monitored and wherever needed the environment management systems are revised through self-assessment and corrective actions.

---

[*] DGM, CESC Ltd., Kolkata, India.

Charter of Corporate Responsibility for Environment Protection (CREP)

As CESC is totally committed to go beyond compliance by voluntarily adopting clean technologies, it endorses the action points of the Charter formulated for Thermal Power Plants. Our generating Stations follow the guidelines and achieve the targets set by the Charter.

Pollution Control Activities

The pollution control activities at our four Generating Stations include:

- Emission control
- Effluent control and effluent recycling
- Ambient air monitoring
- Solid waste management
- Hazardous waste management
- Plantation

Emission Control

Our constant endeavour has been to contain the particulate emission from our pulverized fuel fired Generating Stations not only within the stipulated norms but to achieve the internal targets set well below the statutory limits.

However our oldest Generating Station namely New Cossipore Generating Station is around 60 years old and it had rudimentary emission control facilities for its stoker fired boilers, at the time of inception with almost no environmental norms in place.

However within a span of three years from January 2003, the boilers have been retrofitted with state-of-art emission control equipments and since early 2006 the emission level of New Cossipore are within the statute.

- **Flue Stacks**

  At our pulverized fuel fired Generating Stations tall stacks are provided for extensive dispersion of particulates and other gases emitted due to combustion of coal.

In fact the stacks for our Unit no.1 and 2 at Budge Budge Generating Station measure 275 metres.

- **Electrostatic Precipitators**

  Primarily particulate emissions from the boilers are controlled by highly efficient Electrostatic Precipitators.

- **Wet Electrostatic Precipitators**

  At our New Cossipore Generating Stations having stoker fired boilers as mentioned above we have retrofitted Wet Electrostatic Precipitators (Wet ESP) to the boilers to contain the particulate emission. After frantic search in India and abroad since 2001, to work out a technical solution for retrofitting of emission control equipments as could be possible with severe space constraint besides the difficulty in matching with the very old boiler technology, the workable option was installation of Wet ESPs on the roof of the boiler house. This technology was imported from USA and the equipments were manufactured indigenously under in-house supervision. A pilot demonstration of a Wet ESP plant brought in from USA was tried and found successful. The Wet ESPs have the facilities of water fogging followed by electrostatic separation within the same equipment. Incidentally, installing Wet ESPs is a pioneering project, and no other power plant in the country can boast of such equipment.

- **Flue gas Conditioning**

  Particulate emission at all our pulverized fuel (p.f) fired Generating Stations are further reduced through flue gas conditioning by means of controlled ammonia dosing in the flue path prior to electrostatic precipitation. These automated systems are developed in-house and adopted after extensive experiments.

- **Low-NOx Burners**

  At our Budge Budge Generating Station Low-NOx burners are provided to control NOx emission. NOx emission is also reduced by adopting measures for efficient combustion of fuel at all our Generating Stations.

- **On line emission monitoring equipment**

  Opacity meters installed at our p.f fired Generating Stations monitor the level of particulates continuously and also provides the feed back to the automated flue gas conditioning system which in turn controls the rate of conditioning accordingly. Continuous monitoring equipment for monitoring SOx and NOx are also installed at the stacks of our Budge Budge and Southern Generating Stations.

- **On line data acquisition and management**

  In order to have a close watch on the level of particulate emission these data are displayed continuously not only on the control panels of Control Rooms at our Generating Stations but also in much larger format on special displays on top of the panels alongside the most important performance parameters of the power station. This facility not only makes monitoring easier for the operating personnel but also drives them to attach utmost importance to the parameter.

  These real-time data are also displayed continuously at the Station Managers desk through local area networks of respective Generating Stations, to Executive Director(Generation)'s office at the Company's Head Office and to the Corporate Environment Cell through CESC's own intranet.

- **GHG Emission and Clean Development Mechanism credit**

  The Company has also focused on energy efficient technologies and has adopted various energy efficiency improvement measures in the Generating Stations to accomplish this mission.

  Two initiatives, one each at Budge Budge Generating Station and Titagarh Generating Station have already been registered as Clean Development Mechanism (CDM) projects with the UNFCCC and CERs as applicable were issued to the Company. These measures have resulted in significant reduction in green house gas emissions.

  At Budge Budge we have been able to reduce energy consumption per kwh of energy generation and at Titagarh the original auxiliary fuel combustion system have been upgraded with more energy efficient technology. In both cases, significant saving in coal consumption resulted in reduction in CO_2 generation.

- **Effluent Control**

  The circulating water from the river pumped through the condensers of the units having once-through system goes back to the river without any appreciable change of physical and chemical properties. The temperature of the CW outlet water discharged is monitored so that the difference between the temperatures at intake and outfall remains always within the permissible limit. Treatment of all other effluents generated from different processes and sections of the Generating Station is primarily carried out at the Effluent Treatment Plants (ETP) by controlled dosing of necessary chemicals.

  Neutralising pits are there at all our Generating Stations for treatment of effluent released from the De-Mineralizing Plants prior to its final treatment in ETPs.

- **Effluent Recycling and Conservation**

  All our Generating Stations except New Cossipore have achieved complete recycling of effluent by adopting different modified processes:

  - **Recycling of bottom ash handling water :** These systems not only conserves huge quantity of fresh water normally used for ash handling but also eliminate the possibility of ash laden effluent to be discharged to the river due to improper treatment at any point of time.

    Both our Budge Budge and Southern Generating Station were provided with zero- discharge bottom ash handling system since their inception. In fact this system when installed at Southern was the first of its kind in the country. At Titagarh Generating Station however a similar closed system was developed in-house for handling bottom ash.

  - **Recycling of process effluent:** Other forms of process effluents are primarily treated at the ETPs and recycled after further treatment and polishing through filters, for reuse as service water. All these systems have been developed in-house and put into successful operation.
  - **Cooling Towers:** Cooling towers which facilitates conservation of huge quantity of river water are installed at our Budge Budge Generating station for the Condenser Cooling Water system.
  - **Root Zone System:** This eco-friendly system has been installed at our Titagarh Generating Station for treatment of sewage released from the septic tank overflow and the clean water is entirely reused in gardening and watering of plants. This is in addition to the normal sewage treatment carried out for treatment of sewage in all the plants.

- **Ambient Air Monitoring**

Ambient parameters are monitored at all our Generating Stations and also in the vicinity, according to a fixed schedule and a close watch is kept on the parameters which are always within our internal targets. Work Zone monitoring is also carried out so that people working in pollution prone areas like Coal Handling, Ash Handling and De-Mineralizing Plants are not exposed to undesirable pollution.

Dust Extraction and **Dust Suppression Systems** are provided at the Coal Handling plants to contain fugitive emission of coal dust.

- **Solid Waste Handling and Management**

  - **Ash Handling :** At all our p.f. fired Generating Stations dense phase Dry Ash Extraction Systems are installed by means of which fly ash is extracted and conveyed from the ESP hoppers to the Ash Silos. Bottom Ash is transferred in from of slurry to the Hydro bins through the Zero-Discharge System (as mentioned above) from where after decantation the moist ash is transported in dumpers for land development, construction of roads and structural filling. The handling water however moves in a closed cycle, thus eliminating the possibility of environmental degradation and conserving huge quantity of fresh water.

- **Ash Utilization:** Utilization of fly ash has always been a high priority issue for the CESC's management. A separate Ash Management Cell at the corporate level oversees ash utilization from all the Generating Stations.

  Whole of the fly ash generated at the Southern Generating Station is being utilized in the manufacturing of Portland Pozzolana Cement (PPC).

  Fly ash from our Budge Budge Generating Station is transported pneumatically through pipelines to the Silos on the pontoon jetties at the river front, erected specially for utilization of ash. Ashes from these Silos are directly loaded into covered barges for export to Bangladesh for manufacturing of PPC brand cement.

  At Titagarh Generating Station, an automatic bagging plant has been erected wherein dry fly ash is bagged and transported to cement manufacturers for making of PPC.

  A mechanized brick plant in the vicinity of Titagarh has been erected for making of fly ash bricks.

  Ash from Titagarh is transported in moist form for making of roads, land development and structural filling. Ashes from both Titagarh and Budge Budge have been widely used in construction of all the important roads and highways, constructed in the last decade, in and around Kolkata.

- **Hazardous Waste Management**

All our Generating Stations hold valid authorization by the West Bengal Pollution Control Board for storage and disposal of used oil. Used oil collected from different areas of the Generating Stations are stored in properly closed drums at specific locations and necessary safety precautions are taken while handling the waste within the plant area. Proper housekeeping practices which include fast response to leaks and spills are followed in order to keep the storage locations clean and safe. Used oil from our Generating Stations is sold to the registered re-processors only, through the manifest system as per statute and records of storage and sale are maintained.

As per the order of the Hon'ble Supreme Court of India the Environmental Information in standard formats, in both English and Bengali languages are displayed at the main entrance of all the Generating Stations for public viewing and the information is routinely updated at the beginning of every month.

- **Plantation**

Plantation and green belt development in and around the Generating Stations for abatement of air pollution, attenuation of noise and serving as sink for CO_2 have always been considered to be very important aspects of environment management in CESC. The Generating Stations being located either within or very close to the city area, the space available for plantation is limited. But even within this constraint, trees have been planted in spaces available. At Budge Budge where space available for plantation is more compared to other Generating Stations, a total of over 98,000 trees have been planted and are being maintained under the guidance of expert consultants. Though plantation is an ongoing activity, a further large scale plantation program at Budge Budge will be taken up after the commissioning of the third unit (250 MW) in 2010.

Environmental Management Systems & Occupational Health and Safety Systems

Our p.f fired Stations namely Budge Budge, Titagarh and Southern Generating Stations are ISO 14001 certified and are also Occupational Health and Safety Assessment System OHSAS 18001 certified power station.

Awards and Accolades for Environmental Initiatives

Awards
Budge Budge Generating Station ranked first in the large scale industry sector of Environment Excellence Award, 2006 conferred by Indian Chamber of Commerce & West Bengal Pollution Control Board.
Budge Budge Generating Station received National Award for fly ash utilisation from Ministry of Environment & Forest, Ministry of Power & Dept. of Science & Technology in December, 2005.
Budge Budge Generating Station received Environment Excellence Gold Award in thermal power sector from Greentech Foundation in 2006, 2007 & 2008.
Southern Generating Station ranked third in the large scale industry sector of Environment Excellence Award, 2007 conferred by Indian Chamber of Commerce & West Bengal Pollution Control Board.
Budge Budge Generating Station was the only power station awarded in 'Environment Management in Thermal Power Station' category in National Awards for Meritorious Performance in Power Sector from Ministry of Power, Govt. of India in January 2010 and received a Silver Shield.
Southern Generating Station received Silver Greentech Safety Award 2010 in Thermal Power Sector for outstanding achievement in Safety Management from Greentech Foundation in May 2010.
Budge Budge Generating Station received Gold Award for Best Environmental Performance Power Plant of the Year in Asian Power Awards 2010 organised by Asian Power Magazine.